JUNE 1, 1939 FIRST AERO WEEKLY IN THE WORLD

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The Outlook

The Admiralty Takes Over

AFTER several postponements, the Admiralty at last assumed full administrative control of the Fleet Air Arm on Empire Day, May 24, thus breaking the tradition that all important changes in the British Empire should date from April 1. The temporary R.A.F. commissions held by naval-officer pilots in the Fleet Air Arm have come to an end, and henceforth seniority in that Arm will be purely naval seniority, whether the officer belongs to the ordinary Navy, to the "A" branch, or to the Royal Marines. Observer officers never held R.A.F. commissions, and henceforth pilots and observers will be all on the same footing. As *Flight* was the first to announce (in our issue of January 26 last), it will in the future be possible for observer officers to be given tactical command of a flight and administrative command of a squadron of the Fleet Air Arm, and we understand that in the near future two T.S.R. squadrons will actually be commanded by observers. Fighter squadrons are different, and will normally, if not invariably, be commanded by pilots.

Most of the practice flying by naval pilots will have to be carried out from shore stations, as it is unnecessarily expensive to use carriers for this purpose. Provided that the pilots are quite competent at landing on a deck, it is sufficient that they should put in their ordinary flying hours from a shore aerodrome. Shore stations are also needed for accommodating the ratings of the F.A.A. when they are not afloat, and consequently a new naval division, known as Naval Air Stations, has come into existence, and a Rear-Admiral has been appointed to command it. He will fly his flag at Lee-on-Solent, while a Captain or Commander will command each of the stations which have been handed over by the Air Ministry, namely, Lee-on-Solent, Ford, Donibristle, and Worthy Down. It is understood that presently Lympne and Southampton stations will also be transferred to the Admiralty. Bermuda will also become a Naval Air Station, and will be administered by the Commander-in-Chief, America and West Indies Station.

Ships on Shore

THE Naval Discipline Act makes it necessary that all personnel shall be borne on the books of one of His Majesty's ships, and for that reason all officers doing duty at the Admiralty are on the books of H.M.S. *President*, which is actually the R.N.V.R. training ship moored by the Thames embankment. Those stationed at Portsmouth are on the books of H.M.S. *Victory*. The four new Naval Air Stations, therefore, have to receive the names of ships, and they will take the names of the harbour launches commissioned as depot ships for the stations. The launch at Lee-on-Solent is named H.M.S. *Daedalus*, that for Ford is H.M.S. *Peregrine*, that for Donibristle is H.M.S. *Merlin*, and that for Worthy Down is H.M.S. *Kestrel*. It is not proposed that the depot ships should actually be kept inside the station boundaries; that would present geographical difficulties. It may also be mentioned that though the ratings' caps will bear the name of the depot ship, the stations will normally be referred to by their accustomed names.

H.M.S. *Daedalus* is a name which already has a history in the old R.N.A.S., for that was the Admiralty designation of Cranwell when, in the early days of the war, it was an airship station. For the rest, the names chosen seem to suggest that the Admiralty has a prefer-

FIGHTER CONTRAST: A Bristol Fighter (*circa* 1917) and a Vickers-Supermarine Spitfire seen at Netheravon on Empire Air Day.

ence for liquid-cooled engines. Perhaps, however, that is only intended to balance the other historic names of H.M.S. *Pegasus* and H.M.S. *Hermes*, which have air-cooled associations.

The selection of Rear-Admiral R. Bell Davies, V.C., D.S.O., A.F.C., to be Rear-Admiral, Naval Air Stations, is a further link between the old R.N.A.S. and the new Fleet Air Arm. It was as a Squadron Commander in the R.N.A.S. that he won his Victoria Cross, his Companionship of the Distinguished Service Order, and his Air Force Cross. The story of his gallant deeds is told on our Service Aviation pages in this issue. It should also be noted that of the four station commanders, two are Captains in the "A" Branch of the Navy.

The Fleet Air Arm has thus made a new start, while emphasising that it is the true lineal descendant of the war-time Royal Naval Air Service. It will soon have twelve aircraft carriers afloat, as well as large numbers of catapult aircraft, and so should be the most powerful naval Air Force on this side of the Atlantic. *Flight* offers its best wishes for a fortunate and, if necessary, victorious career, and hopes to follow its doings in the future as it has tried to do in the past.

Parliamentary Performance Puzzles

TRULY the ways of the Air Ministry are passing strange. It invites members of the Lords and Commons, and other distinguished visitors, to a Royal Air Force Demonstration at Northolt, as recorded on pages 564a-564c of this issue. The R.A.F. gives a wholly admirable show, and the commentator, Sqn. Ldr. Donaldson (who is himself one of the crack aerobatic pilots of the R.A.F.) supplies an entertaining and informative explanation of all that happens. The Air Ministry produces an attractive and well-produced programme, and then one finds the most puzzling performance figures quoted, which seem to bear little relation to realities. In one instance they are unduly pessimistic and in another they err in the opposite direction.

In the foreword it is stated that "The speeds in each case are for the maximum range with full military load." For example, the speed of the Bristol Blenheim is given as 285 m.p.h. and the range as nearly 1,000 miles. But it is well known that that range does not correspond to that speed. Similarly with the Handley Page Hampden, the speed of which is given as 265 m.p.h. and the range as 2,000 miles. Again the figures do not tally in the least with those published in *Flight* of May 4, 1939, which had been approved by the Air Ministry.

On the other side of the picture we find the top speeds quoted for the Hurricane and Spitfire fighters far lower than we have been accustomed to. Yet too high to correspond to maximum range.

The answer seems to be the old one, that a mouse is when it spins because the higher it goes the fewer.

Improving Three Shining Hours

THE other day a Queen Bee aeroplane survived for three hours the salvoes from the anti-aircraft guns of the Home Fleet, and the first report did not state that the shells had no bursting charges. They were, in fact, not shells but large bullets. For the moment, however, it seemed to some that the Fleet was almost powerless against air attack. If that conclusion had been justified, there would have been cause for gloom, for air power can certainly not secure our supplies of food and other requisites in time of war.

It is, however, notoriously injudicious to jump to conclusions as a result of any form of sham fighting. Even if the shells had burst, and yet the Queen Bee had survived, that would not have proved the case of the pessimists. It would not have proved that aircraft could have prevented the Fleet from carrying out its work. In any case, it is hardly conceivable that any pilot would have remained under fire for anything like three hours, or, when the shells were bursting near him, that his bomb-aiming would have been very accurate. In the Great War pilots learnt how to avoid "Archie" shells, but only the reconnaissance machines were expected to stay within range of them for very long at a time. No pilot enjoyed being under A.A. fire.

The point to keep in mind is that if air attack cannot prevent the Fleet from carrying out its duties, then naval power remains the chief bulwark of Britain. We may also reflect that if any enemy aeroplane stayed too long over a fleet, the fighters from that fleet might also have a word to say.

Forthcoming Events

JUNE.

Sat., 17th. Official opening of Derby Municipal Airport (Burnaston) by Sir Kingsley Wood. Brooklands Flying Club "At Home."

Wed., 21st. Aero Golfing Society: Jubilee Cup, Berkshire Golf Club.

Sat., 24th. Royal Air Force Garden Party.

JULY.

Sat., 1st. South Staffordshire Aero Club: Walsall Air Display.

Opening of Grangemouth (Scotland) Airport by Lord Trenchard.

Lancashire Aero Club: Garden Party at Woodford.

Sat., 8th. Official Opening of Birmingham Airport (Elmdon) by H.R.H. the Duchess of Kent.

Sat., 8th-Sun., 16th. National Gliding Contests, Great Hucklow.

Sat., 8th-Sun., 23rd. Brussels Aero Show.

Sat., 15th. Gosport Reunion, Brooklands.

Sat., 15th-Mon. 17th. Deauville Air Rally.

Sun., 16th-Sun., 23rd. Italian Aero Club: Littorio Rally, Rimini.

Sat., 22nd-Tues., 25th. Aero-Club de l'Ouest de la France: Plantagenet Rally.

Fri., 28th-Sun., 30th. Cannes Aero Club: Deauville-Vichy-Cannes Rally.

Sat., 29th-Sun., 30th. Frankfurt International Flying Meeting.

FOURTH OF THE SERIES

The Isle of Man Races Described : G. R. de Havilland (T.K.2) Wins the London-Ronaldsway Event, A. Henshaw Sen. (Vega Gull) the Manx Air Derby, and Sqn. Ldr. H. R. A. Edwards (Avian) the Tynwald Race

Illustrated with "Flight" photographs.

BY way of a change, the weather was very nearly ideal for the three Isle of Man races last week-end. Two years ago the competitors in the long-distance race arrived at the Island to find fog over most of it (and at the Maughold Head turning point in particular), and last year the circuit races had to be postponed from Whit Monday to the much less suitable Tuesday because of low cloud and a very strong wind. The result—especially important from the organisers' point of view—was that the general public, as well as the entrants and sundry enthusiasts, this year arrived in force at Ronaldsway.

Actually, the organisers were lucky as far as Saturday's event was concerned. Until mid-day, a front over the North of England caused a good deal of trouble, with clouds at 300ft. or so, but it had moved on or largely disintegrated before the start at about 12.30 p.m. and all was comparatively well. Even on Monday there was mist about the Island in the morning, but this had almost cleared before the first Tynwald pilot left at 2.15 p.m.

The winner of the Manx Air Derby, Mr. Albert Henshaw, Sen., who flew with Mr. Alex Henshaw as co-pilot. His Vega Gull averaged 167½ m.p.h.

With perfect weather, the size of the crowd at Ronaldsway, both for the Saturday and Monday events, should have made the organisers feel that these are well worthwhile. This photograph was taken on Monday.

This race, incidentally, was the only one to be described as a partial failure. Of seven entrants, only four finished the course, though there was a considerable and exciting battle between the two widely dissimilar leaders during the whole of the ninety minutes it took them to cover the three laps. With less than a minute's start on Sqn. Ldr. H. R. A. Edwards' ancient but fast Sports Avian, R. L. Porteous managed to hold his own with the Ford-engined Chilton until the very last lap, when his machine dropped a couple of miles an hour and was defeated by a mere 26 sec. The Avian had averaged 106½ m.p.h. and the Chilton about 105 m.p.h.

Real Handicapping

Of the three races, the Manx Air Derby was the nearest approach to the handicappers' dream. Messrs. Dancy and Rowarth *nearly* had a line-abreast finish. Over a 156-mile course all nine competitors arrived within six minutes, and the first seven inside two minutes. There was actually a gap of 33 sec. between the winner and the runner-up, 46 sec. between the first and third, and a little over one minute between the first and fifth. Which looks a little dull in black and white, but is the story, in fact, of a remarkably exciting finish.

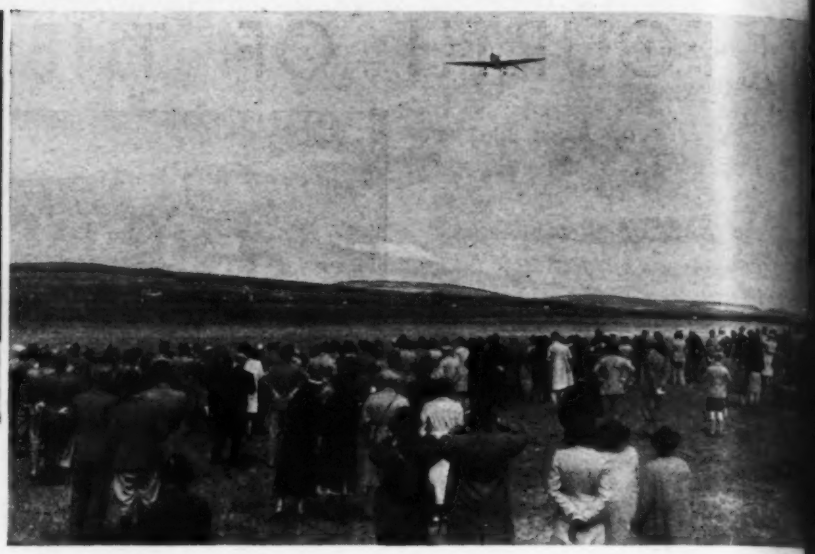
Popularly enough, the winner was none other than Albert Henshaw, Sen., with his Vega Gull, and assisted unobtrusively by Alex Henshaw. A very happy ending to a somewhat difficult period on the starting line, during which Henshaw, sen., was quite determined to fly his own machine in a race for once in a way and Alex was equally determined that he should be chaperoned. Eventually the Mew Gull, which had been second in the London-Ronaldsway race, was taxied away, while Alex went as co-pilot in the Vega.

In the London-Isle of Man race a more or less continuous head wind, which was somewhat stronger than the Met. people had forecast, automatically caused the fastest machines to take all the top places. For once in a way this was a good thing; everybody, somewhat naturally, likes to see the back-markers come up through the field, and it is always slightly depressing when a vintage type, however enthusiastically

LONDON TO ISLE OF MAN RACE

Order	Pilot	Machine	Starting Time	Finishing Time	Speed
			hr. min. sec.	hr. min. sec.	m.p.h.
1	G. R. de Havilland ...	T.K.2	13 36 34	15 07 47	168½
2	Alex. Henshaw	Percival Mew Gull ...	13 57 23	15 08 12	217
3	E. W. Percival	Percival Mew Gull ...	13 59 26	15 09 17	220
4	L. Fontes	Miles Hawk Six ...	13 38 34	15 09 48	168¼
5	R. A. Winter	Gipsy Swift	13 20 52	15 10 01	140½
*6	J. Rush	Miles Sparrowhawk ...	13 30. 32	15 13 27	149½
7	Lord Londonderry ...	D.H. Hornet	12 48 12	15 14 43	105
8	T. W. Brooke-Smith ...	Miles Falcon	13 28 45	15 15 42	143¾
9	P. Avery	V.E.F. J.12	13 10 43	15 16 01	122½
10	H. R. A. Edwards ...	Avro Avian	12. 28 37	15 17 00	91½
11	G. E. Bowes-Stoney ...	B.A. Double Eagle ...	13 37 04	15 19 07	150½
*12	S. Cummings	Blackburn Bluebird ...	12 39 04	15 19 32	95½
13	W. H. Moss	Mosscraft	12 57 21	15 19 39	108
14	J. M. Barwick	Percival Vega Gull ...	13 26 53	15 20 55	134½
15	T. Rose	B.A. Eagle	13 09 52	15 26 27	112½
16	Misses M. and S. Glass...	B.A. Eagle	12 54 04	15 33 06	98½
17	W. Humble	B.A. Eagle	13 01 29	15 39 07	97½

* Disqualified



An unexpectedly strong headwind gave the London-Isle of Man race to the fast machines. The winner was F/O. G. R. de Havilland (above) with the T.K.2, which is seen on the right as it crossed the finishing line.

Second and third in the main race—Mr. Alex Henshaw (above) and Capt. E. W. Percival—who each flew a Mew Gull.

flown, struggles over the line as a winner.

The wind, blowing approximately from the north-west, was probably as strong as 20 m.p.h. in the North of England, while one of only about 10 m.p.h. had been allowed for by the handicappers. Even at the Blackpool turning point the result could be very largely forecast. Though Edwards, the second man to leave Hatfield, had taken a momentary lead, with Lord Londonderry's Hornet a minute or so behind, R. A. Winter's Gipsy Comper (last year's winner—when owned by Lowe) had moved up from eleventh to fourth place, and G. R. de Havilland's T.K.2 was in sixth place after starting fifteenth. The slide-rule experts gave him as the probable winner, though L. Fontes with his Speed Six Hawk was only two minutes behind him, and nobody had yet calculated the chances of the two Mew Gulls, flown by Alex Henshaw and E. W. Percival.

Sure enough, the T.K.2 was the first to appear over the hills to the north-east of Ronaldsway, but when he crossed the line Henshaw's Mew Gull was already in sight and, at the line, there was only about twenty seconds between them. The next three machines, led by Percival's Mew Gull, arrived a minute later—and from a somewhat peculiar direction. Apparently the Mew Gull had oil on its screen and Percival deliberately flew to the right of his course so as to be sure of avoiding other machines. Winter, in the Gipsy Comper, had dropped his map while rounding the mark boat in Douglas Bay, and had to guess the course of the last leg. Neither of these competitors, nor the fourth man home, Fontes, had been in the race before—a fact which might also help to explain the deviation. Altogether, it was all very unfortunate for the pilots of the slower machines.

Unlucky

Although there were fewer starters this year, every one of the nineteen came to the line and there were only two casualties. The Chilton flown by Dawson Paul had had its Ford engine hotted up and there had been little time to run it in before the race. Paul put it down at or near Meir Aerodrome, Stoke-on-Trent, with a seized valve. Which was a pity, because this particular Chilton was reputed to be rather unusually fast. A Miles Whitney Straight, flown by E. A. Strouts, forced landed at Chelford, in Cheshire, and apparently the wrong field was chosen; at any rate, it was out for good with a wrecked undercarriage.

Of course, there was the usual rumour that someone had fallen into the sea, and everybody imagined that it must be Bill Humble with his Eagle, rockets and all. Actually, Humble, realising that he did not stand a chance, had throttled back for the sea crossing, and was consequently somewhat late to arrive. Philip Avery, however, had an unpleasant moment with the V.E.F. At Blackpool he was well up on his handicap, but the head wind had upset his consumption calculations, and half-way over the sea he found that his fuel gauge was showing just nothing at all; he was forced to throttle back, hoping for the best, but ruining his chances in the race. As it turned out later, both S. Cummings' Blackburn Bluebird and J. Rush's Miles Sparrowhawk were disqualified for turning inside the mark at Stanley Park. The Bluebird, incidentally, had been somewhat specially faked, with a cover over most of the side-by-side two-seater cockpit and other items, while the engine had been suitably dealt with by Cummings, who, as a matter of interest, is a motor racing expert.

During the first lap in the Tynwald Race, which was timed so that it would finish comfortably before the concurrently run Manx Air Derby, Porteous' Chilton and Edwards' Avian had taken the lead with the gap between them already closing. Because the three faster aircraft in this race for 120 h.p.-or-under machines disappeared from the

Lord Londonderry, who flew his Hornet Moth into seventh place in the London-Isle of Man race, with his navigator, Flt. Lt. H. T. Ferrand of No. 502 (Ulster) (G.R.) Squadron.

Sqn. Ldr. and Mrs. Edwards after the former had won the Tynwald race with his ancient Avian—which is seen on the left just after crossing the finishing line at a phenomenally low altitude.

running, there was very little more to be said about it. Avery's V.E.F. or Winter's Gipsy Swift might well have come up through the small field, but, unfortunately, both were forced to retire.

The V.E.F. was suffering from some obscure fuel syphoning trouble, which not only caused its retirement after two laps, but also explained Avery's somewhat queer turning tactics. He would enter a turn steeply and then apparently find it necessary to ease out again.

The Comper lost its oil pressure and after the end of the first lap Winter cruised round Ronaldsway until everybody had got off in the Manx Air Derby, finally making a safety-first rumble approach towards the longest run of the aerodrome. The third disappearance, that of Cummings in his Bluebird, might have been much more serious than it was. He was forced down into (or hit) the sea off Peel and swam around for forty minutes before he was picked up. The Bluebird, strangely enough, stayed afloat though on its back, during the period, but finally sank while it was being towed ashore. Cummings was lucky in not being knocked out, since, after the impact, he was under water, and inverted at that. Of the other possible entries, the Luton Major, had been grounded at Speke on its way over, and the Mosscraft had damaged its airscrew on the previous day.

Reshuffling

By contrast the nine competitors in the Manx Air Derby all completed the three laps, and during the period there was the most considerable reshuffling. At the end of the first lap there were two changes, A. Henshaws' Vega Gull having overtaken J. M. Barwick's similar machine, and Tommy Rose's Hawk had gained the ten seconds or so which it had given to De Havilland's T.K.2; the pair of them came round within a few yards of one another. In the next lap the Henshaws had moved up another place, and three of the faster machines—Rush's Sparrowhawk, the Speed Six Hawk and the T.K.2—had all overtaken Barwick's Vega.

It was during the last lap, as might be expected, that the real and vital changes occurred. Until then E. W. Percival, flying his Mew Gull from scratch, had only been closing in on the field and was still running ninth. Unfortunately, he could not quite catch the Vega Gull and the Speed Six Hawk, though he crossed the line only thirteen seconds behind the latter, and had worked up from ninth to third place in less than fifty miles. Until the actual results were announced it was difficult to know whether fourth place had been taken by the T.K.2 or by T. W. Brooke-Smith's Miles Falcon. The two crossed the line together, and by the time their positions could be seen from the enclosures the T.K was a few yards ahead. The finishing line, however, was in the middle of the aerodrome, and the judges ruled that the Falcon was ahead by one second—which amounts to about the fuselage-length of the Falcon.

Side-shows

As the Island races finished quite soon after 4 p.m. and the spectatorial attendance at Ronaldsway was considerable, it was just as well that two other flying items had been arranged. F.O. de Havilland took the T.K.2 up for an aerobatic display at suitably low altitudes, and Mr. Benno de Greeuw afterwards made a jump with a G.Q. parachute from Mr. Ward's Tipsy. F/O. de Havilland's engine-off upward rolls gave a clear idea of the sheer cleanliness of this racing machine, which, in any case, does something like 190 m.p.h. on the mere 130 h.p. of a Gipsy Major. Unfortunately, the wind was not quite as strong as Mr. de Greeuw had estimated, and, after a minor delay which lost him perhaps 500ft. of his initial 2,000ft. or so, he finally came down two fields away from the aerodrome.

TYNWALD AIR RACE

Order	Pilot	Machine	Starting Time*	Finishing Time*	Speed
			hr. min. sec.	hr. min. sec.	m.p.h.
1	H. R. A. Edwards ...	Avro Avian	0 02 44	1 33 52	100½
2	R. L. Porteous	Chilton	0 01 50	1 34 18	105
3	E. Mole	Tipsy	0 00 00	1 39 28	97¾
4	E. D. Ward	Tipsy	0 00 28	1 40 57	96¾

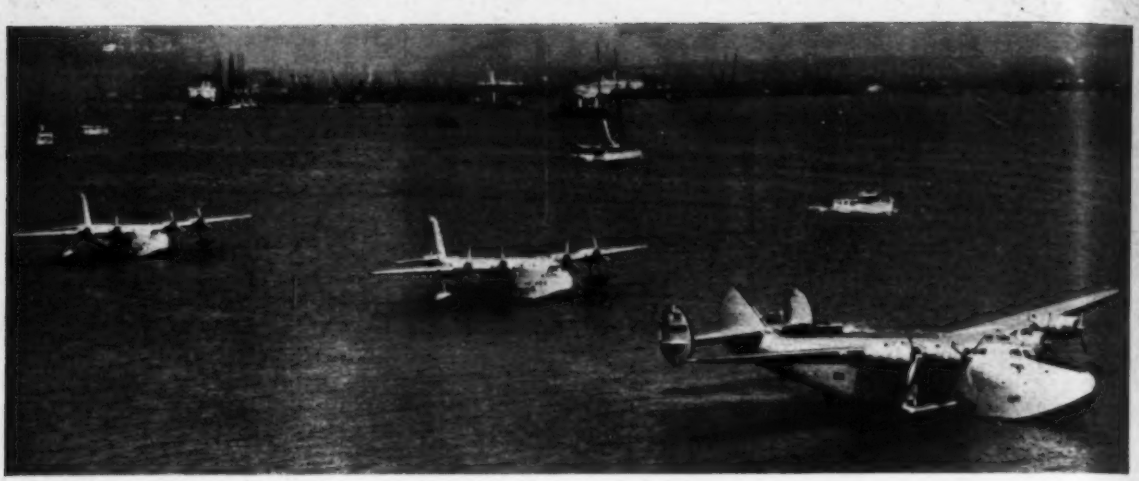
MANX AIR DERBY

Order	Pilot	Machine	Starting Time*	Finishing Time*	Speed
			hr. min. sec.	hr. min. sec.	m.p.h.
1	A. Henshaw	Percival Vega Gull ...	1 02 24	2 09 24	167½
2	T. Rose	Miles Hawk Six ...	1 08 55	2 09 57	186¾
3	E. W. Percival	Percival Mew Gull ...	1 29 08	2 01 10	237
4	T. W. Brooke-Smith ...	Miles Falcon ...	1 01 17	2 01 27	161½
5	G. R. de Havilland ...	T.K.2	1 08 46	2 01 28	184½
6	J. Rush	Miles Sparrowhawk ...	1 03 50	2 01 42	168
7	C. Napier	Percival Gull	0 54 04	2 02 10	142¾
8	J. M. Barwick	Percival Vega Gull ...	1 01 40	2 05 20	152¾
9	Misses S. and M. Glass...	B.A. Eagle	0 41 42	2 06 31	111·7

* Add to 14 hr. 15 min., the starting time of the first competitor away.

Some notabilities: From left to right they are Major Alan Goodfellow, Capt. E. W. Percival, Lord Londonderry, Vice-Admiral W. S. Leveson-Gower (the Lieutenant Governor of the Isle of Man), Councillor W. C. Craine (Mayor of Douglas) and Lady Rose Leveson-Gower.

COMMERCIAL AVIATION



THE YANKEE CLIPPER moored near two Empire boats at Southampton after her second Atlantic crossing.

THE WEEK AT CROYDON

"A. Viator" on the Whitsun Rush, Imperial's Pioneer Pilots, and Ways They Have in the Navy

WE shall not get the Whitsun air-traffic figures yet awhile, but when we do I expect they will be of the bumper variety.

On Friday of the holiday Air France carried close on 250 passengers out from England, and on that day (and since) the blue skies have been darkened by hurrying Blochs. Le Touquet has been popular, and Le Zoute, too, the latter service being operated by North-Eastern Airways, whose line to the North has also been doing extremely well lately.

To the North from Amsterdam and beyond there has been a considerably increased air traffic by K.L.M., largely of fruit and flowers; whilst outwards from Liverpool, Manchester and Doncaster passenger traffic has been brisk.

One aeroplane left England for Holland on the K.L.M. Northern route fully loaded with passengers for as many different European cities as Budapest, Vienna, Stockholm, Copenhagen, Berlin, Amsterdam and Rotterdam.

Swissair have been extremely busy as usual, and Imperials have run to capacity. K.L.M. and D.L.H. have maintained a steady average, but, in the main, public holidays do not affect these firms much, their passengers being largely business folk. You never see golden-haired young men in parti-coloured shoes and wearing carnation button-holes on these lines, nor grandmothers disguised as giggling débutantes.

But to places like Le Touquet, especially at holiday times, you see all the sort of English who make foreigners so confident that the British Empire is cracking up rapidly. A short life and a gay one would seem to be their motto. They are not very obviously gay, however; mixed hectic-cum-peevish is the usual aspect. As for a short life—perhaps one can agree with them there.

Capt. Digby, of Imperial Airways, who used to be in the East on "boats," but who has been on the European lines for the past eighteen months or two years, is leaving the firm, I hear, to join the Air Registration Board. Good luck go with him. Which brings me to the point that old pilots never die, but merely fade away. Look back five years at the "Captains Courageous"—the men, I mean, who really founded the business and took all the early risks, who wrote the name Imperial Airways across the skies by getting through "in most weathers, hanging on behind the odd prop or props turned by engines which might—or, again, might not, and quite frequently didn't.

Some are doing sterling work in ground jobs of importance; and others have gone elsewhere, but at the moment there are very few of the earliest Imperial Airways pioneers actually flying regularly on European routes, anyway.

There is the perennially youthful Wilcockson, there is Jimmy Youell and there is Horsey. I can't think of a lot of others at the moment except O. P. Jones. Perhaps these, too, when the Amalgamation gets under way, will be offered ground jobs where their vast experience will be of untold value to the company. On the other hand, it is possible that, like true merchant skippers, they prefer to go on with the job they love until retirement.

Naval discipline must be maintained, of course, but is it necessary to rename all sorts of quite good aerodromes, as if they were battleships? Lee-on-Solent, Ford, Worthy-Down and Donibristle, have actually, solemnly and without a smile been re-christened H.M.S. *Dædalus*, H.M.S. *Peregrine*, H.M.S. *Kestrel* and H.M.S. *Merlin*. That's the spirit! I suppose they'll splash salt and water about and yell "Heave ho!" at anyone who has had a bumpy trip, and at night, when the floodlights and pyrotechnics are at full blast, everyone will get that nice "all lit up" feeling. All I can says is, if you name a field after a ship you must expect the whole place to roll and plunge one of these wet nights, with half seas over the boundary fences and all the rest of the jovial seafaring stuff.

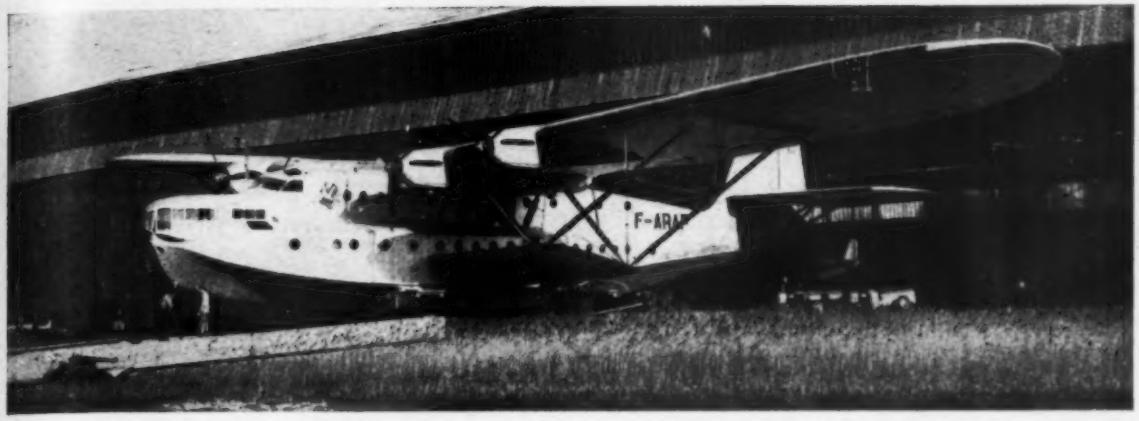
There has been a big rush of air freight from Holland, especially recently. Strawberries and cut flowers, mostly, but quite a lot of bullion too. As well as the regular night freight machine of K.L.M. and a considerable amount on other services, there has been an extra freighter every night for a week and last Thursday there were two extra.

G.A.P.A.N. Master Instructor's Diploma

AFTER a considerable period of exploratory enquiries, the G.A.P.A.N. has decided to issue a Master Flying Instructor's Diploma

In brief, it will be awarded to instructors holding the G.A.P.A.N. Full Instructor's Certificate who have completed 2,500 instructional hours (or equivalent) during five out of eight years of flying within the British Empire, and who can show a clean record.

We hope to make further reference to the Diploma.



ATLANTIC ADDITION: The new Latécoère 521, *Ville de Saint Pierre*, which has recently been undergoing pre-Atlantic trials at Biscarosse, where the machine is seen here. It follows the lines of its predecessor, the well-known *Lieutenant*, and will be used with the latter for Air France Transatlantique's experimental crossings, preparatory to the appearance of still larger boats which are in course of construction.

Another Warsaw–London Connection

FOLLOWING the start of British Airways' London-Berlin-Warsaw service, Polish L.O.T., as reported in recent Croydon notes, started a new service between Warsaw and Copenhagen on May 15. This service connects comfortably with the regular K.L.M./A.B.A./D.D.L. services between Copenhagen and London. The L.O.T. section is via Gdynia, and a D.C.3 was used on the inaugural run. Incidentally, the first service between Poland and Denmark was opened by the same company in the middle twenties, when experimental runs were made with a single-engined Junkers on floats.

Ready for the next winter season, new radio equipment is being installed at Copenhagen's airport at Kastrup. This will consist of an Adcock D/F receiver. At present an ordinary loop aerial is used, with, of course, ultra-high-frequency blind approach equipment.

S.A.A. Ju. 90s

IT is expected that the first of the two Junkers Ju. 90s which have been ordered by South African Airways will be delivered in August. As soon as the two machines are in service the company will start a new non-stop run between Johannesburg and Cape Town.

Since these particular Ju. 90s are intended for long-distance services, they will have a rather more ample tankage than standard, and will accommodate only thirty passengers against the forty for which the machines were originally designed. The four engines will be Pratt and Whitney twin Wasps, which should give the machine a cruising speed of about 220 m.p.h. In many ways the S.A.A. Nineties will be similar to the Douglas D.C.3 Clubplanes (comfort before capacity) which are used by one or two of the American operators for special non-stop services.

Another Atlantic Week

AFTER *Flight* had gone to Press last week the Pan-American Airways' Boeing 314 completed the last stage of its journey by flying from Marseilles to Hythe, Southampton, in five minutes less than five hours. Capt. La Porte put down in Southampton Water at 12.45 p.m. This was on Tuesday, May 23. No mail, following the present agreement, was brought from Marseilles, and none was taken on the return journey, which started on May 24.

After a gap of a day, the *Yankee Clipper* flew from Marseilles to Lisbon in just over seven hours. Another boat, *Atlantic Clipper*, in command of Capt. Gray, was due to leave Port Washington at the time when *Yankee Clipper* reached Southampton, but on Friday of last week no further information was available.

After an initial decision by the G.P.O. not to accept mail for transport by the American flying boat across the Atlantic, the Postmaster General announced last week that letters for the U.S., Canada, Newfoundland and the Azores could be accepted for transmission from Marseilles by the Pan-American service. The postage rate is 1s. 3d. per half-ounce for America, and 6d. per half-ounce for the Azores.

Meanwhile the old *Lieutenant* arrived at Bordeaux on May 25 after completing the last stage of the first of the season's experimental trips to New York and return. A similar, but modernised, Latécoère boat of the same type is being got ready for the work by Air France Transatlantique.

The Tasman Service

THE first of the strengthened "C" class Short boats for the Tasman Sea service, *Aetearoa*, is due to leave England for Auckland, N.Z., towards the end of this month. The machine will be flown out by easy stages and will be used during the next few months for training purposes. The actual service is not likely to come into operation until September.

Australian Merger

IT appears that the Australian Government may shortly reach an agreement with the commercial airline companies on its plans for avoiding uneconomic competition on the main routes. The agreement will be in the nature of a "stop-gap" until the Government has had time to consider plans for a long-term agreement. Eventually, it is believed, a series of agreements for five years will be reached with the operating companies. A committee is investigating the matter, and its report is understood to recommend the payment of subsidies amounting to nearly £400,000 for the maintenance of domestic air services. Before such a scheme can, however, be introduced at least three months must, according to the Minister for Civil Aviation, Mr. Fairbairn, elapse.

Radio Training

ORIGINALLY intended only for the training of operators and engineers employed by Marconis, and for the personnel of Imperial Airways, the Marconi Training School has now been expanded so that all operators and prospective operators may take courses there. Instruction is arranged to suit each student's individual requirements and there are no fixed sessions.

The courses include, of course, those for R/T. and W/T. certificates, for the signalling, D/F and blind-approach section of the Second-Class Navigators' examination, for R.A.F. operators requalifying, and for special revision. An an example of the fees charges, a nine months' course for the full W/T. certificate is offered at thirty-five guineas—or five guineas a month if the student has had previous experience and knows that he can complete the course in less than the normally stipulated period.

The school is under the control of the Marconi experimental establishment at Hackbridge, and the training is carried out at "Rathmore," 6, Stanley Park Road, Wallington, Surrey. The chief instructor is himself a man with long experience both of radio operation and of equipment installation, and he has at his disposal, of course, any personnel whom he may require from the other Marconi establishments. Since this company's equipment is used more largely than any other in British aircraft, the school should be well fitted to offer up-to-date training.

SUMMER AT SCHIPHOL : This aerial view of Amsterdam's airport gives an idea of the tremendous number of people who are encouraged to come out during the weekend and on fine evenings in the summer. On the tarmac are half a dozen assorted Douglas while on the right are F.22's and F.36's, which are now used for joy riding. The Schiphol runway extensions to the north are now complele.

Fourteens for the Dublin Service

AER LINGUS TEORANTA, or Irish Sea Airways, have recently been very silent about their plans, and the announcement that they have ordered two Lockheed Fourteens for the service between Dublin, Bristol, and London has come from America. The machines, which will be fitted with Pratt and Whitney Hornet engines of 850 h.p., should by now be on their way over by boat. On the Dublin-London run the Lockheeds will reduce the present schedule by about an hour. They will be equipped to carry nine passengers with a crew of four, including a stewardess.

Tasman Investigations

FOLLOWING the successful collation of weather data over the North Atlantic by a meteorologist who travelled backwards and forwards on the S.S. *Manchester Port*, a similar scheme is being applied to the necessary investigations over the Tasman crossing. In this case the S.S. *Awatea* has been equipped with a special research station which will be in charge of Mr. Alan Martin, who was recently engaged in making observations in Tasmania.

During his trips across the Tasman Mr. Martin will obtain the usual upper-air observations by the use of meteorological balloons and will transmit special reports by radio to the aerodromes at Sydney and Auckland.

A New Blind Approach System on Test

THE United States Civil Aeronautics Authority have arranged with the U.S. Army to conduct practical flight tests of the Metcalf-C.A.A. blind-approach system. These tests will be carried out at Wright Field, Dayton, Ohio.

This blind-approach system, which was described in *Flight* of September 15, 1938, involves the use of cathode ray tubes on the flat surface of which three lighted dots indicate to the pilot whether he is on his correct approach line or not. These dots make up, so to speak, the plane of approach, and may be described as being the equivalent of three lights, one at the end of the landing runway and two, on either side of the start of the runway, suspended in mid-air. Hence, if the three dots are in line and equi-distant, the machine is on the correct approach line. The machine's normal artificial horizon and directional gyro control the movements of the outer dots, while the centre dot is controlled by radio. An important point is that a single instrument on the panel gives the pilot all the information he needs.

The Sydney Base

THE comparative inadequacy of the accommodation at the Rose Bay base, Sydney—referred to in *Flight* a few weeks ago—is reviving the idea, put forward some time ago, that an artificial lake should be engineered near the Kingsford-Smith airport. This airport is laid out near a river, and is separated from it only by swamps. The suggestion is that part of these swamps should be reclaimed for airport extension, and that a further area should be dredged to make the proposed flying-boat base.

Imperial's New Terminal

ON and after next Monday, June 5, all passengers for the European services of Imperial Airways, S.A.B.E.N.A., D.D.L., D.L.H., A.L.I., and Swissair, as well as the internal R.A.S. services, will be leaving and arriving at, so far as London is concerned, the new Imperial Airways building in the Buckingham Palace Road.

By then all the essential traffic staff will have been transferred from Airway Terminus, and the rest of the considerable staff of Imperial Airways will presumably be moving in very shortly. Apparently it has been found that even this large building is not quite sufficient, and extensions have had to be made.

New Service in Indo China

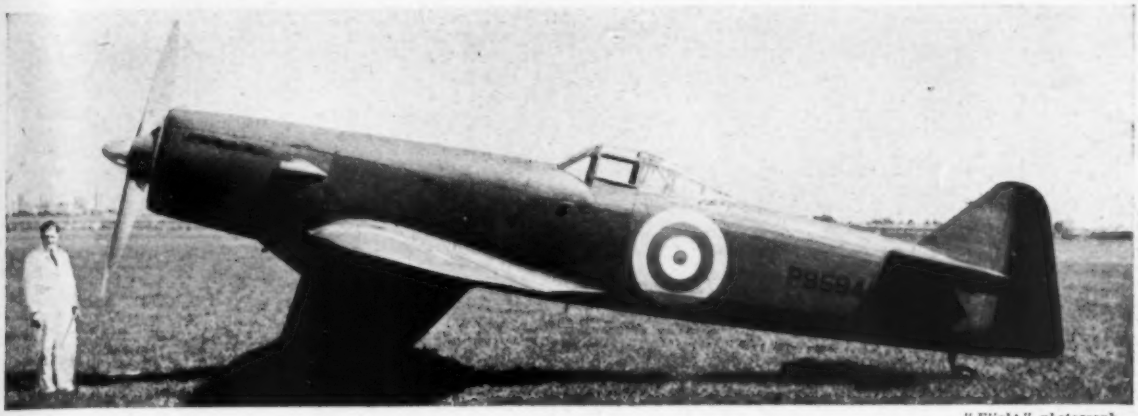
A NEW shuttle service between Saigon and Hanoi, serving the interior of French Indo China, is to be started on July 1. This branch line, which covers a section of the route followed by the weekly long-distance mail service from Europe to China, has been much talked about since the Dewoitine 338's were put into service last year and Hong Kong became Air France's Far Eastern terminus.

It will be remembered that, prior to this, the line split up at Bangkok, one connection running to Saigon, the French Colonial capital, and the other—that carrying the China mail—flying over the Siamese jungle, via Vientianne, to Hanoi, whence it was carried in a Chinese machine to Canton. The speed of the Dewoitines, however, made it possible for the same machine to call at both Saigon and Hanoi and proceed to Hong Kong without loss on the schedule time, and the two towns became directly linked by air for the first time.

The new service, which is likely to be a daily one, will serve the interior of Cochin China by landing at Laos and Vientianne, two important inland centres. It has come into existence following an agreement with the Chinese Government.

A NEW MULTI-GUN FIGHTER

Dagger-engined Martin-Baker Demonstrated : Unique Structural Features.



"Flight" photograph

The square-cut appearance of the new Martin-Baker multi-gun fighter is accentuated by the lines of the nose cowl over the Napier Dagger engine. There is an electrically operated "crash post" which is normally housed within the cockpit enclosure.

EASE of production is, perhaps, the chief recommendation of a new single-seater multi-gun fighter monoplane demonstrated by The Martin-Baker Aircraft Co., Ltd., of Higher Denham, at Heston last Friday. It is claimed that all parts can, if necessary, be fabricated in small workshops throughout the country and be sent to a central factory for final assembly. According to Mr. J. Martin, chairman and chief designer, twenty machines a week could be turned out by a factory employing 2,000 people.

The Martin-Baker monoplane is unique among British fighters in that its length is greater than its span, its wings measuring 34ft. and its fuselage 34ft. 6in.

With the exception of the wing covering the machine is entirely of steel construction which, according to the designer, is an important point when there is such a big demand for duralumin. Quickly detachable panels are fitted round the fuselage, which is of tubular construction. The cockpit enclosure is unique in that the main portion hinges back toward the starboard side, allowing not only easy entry and exit but access to the front and back of the instrument panel.

Oil coolers are fitted in the undercarriage leg on the port side, and the cooling air for the Napier Dagger 24-cylinder, 1,000 h.p. engine is exhausted through a controlled outlet on the underside of the fuselage.

Only external inspections were permitted at the demonstration, but one noted the masking plates over the elevator and rudder gaps and the jacking points on the underside of the wings to enable the machine to be raised should it be necessary to change a tyre.

Capt. V. H. Baker, who has done all the contractors' test flying on the machine, took it up to 10,000 ft. and put it into what appeared to be a vertical dive with engine off, reaching at least 400 m.p.h. when the A.S.I. needle went "off the clock." Particularly impressive was the tightness of the turns due, no doubt, to the comparatively short span of the machine. Originally no fin was fitted, the machine depending for directional stability on the side area of the fuselage, but the tail is now more or less of orthodox design.

"Flight" photograph

Perhaps the most remarkable feature of Capt. Baker's demonstration was the tightness of his turns near the ground.

"Flight" photographs.

The men behind it (left to right) : Capt. V. H. Baker, Mr. J. Martin and Mr. Francis Francis (Martin-Baker Aircraft) ; Sir Harold Snagge (chairman of Napiers), Maj. F. B. Halford (designer of the engine), Mr. A. E. Hagg and Mr. W. P. Savage, of Napiers.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

ALTIMETER CORRECTION

A Plea for "Vertical" Pressure-distribution Charts

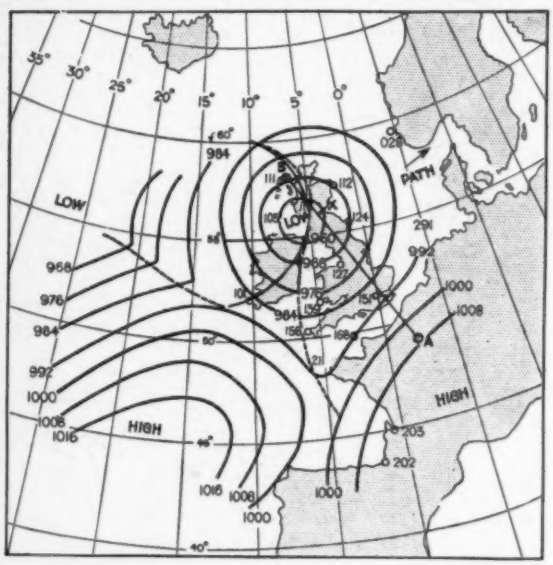
I HAVE often wondered if many of the accidents in the air, both in this country and America, caused through aircraft flying into the sides of hills, could have been avoided if the pilots had at their disposal correction charts for their altimeters.

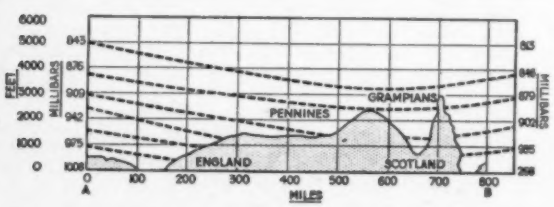
Every pilot has at his disposal, on leaving any airport, a chart showing the pressure distribution over the British Isles and the Continent. From this he can see at a glance whether he is flying into high or low pressure, and is also able to set his altimeter for the level of the airport he is leaving or for sea level.

Might I suggest that, in addition to this, the pilot should also be given a plan showing the *vertical* distribution of pressure as well as the horizontal, so that at any time during the flight he will be able to see, without having to calculate, the error of his altimeter at any moment during the flight?

Whilst realising that such a plan would not be perfectly accurate, temperature in the upper air not being exactly known, I feel that a plan sufficiently accurate to within a hundred feet of altitude could be made by an experienced meteorologist in a few seconds and handed to the pilot before taking off.

The accompanying sketches will illustrate such a scheme in actual practice. The pilot ascends at A on a flight to B. He





attains an altitude of, say, 1,200 feet by his altimeter. If he maintains that altitude by his altimeter throughout his flight he will, on reaching the point X in the weather chart, be at the danger point, as regards height, on the particular route he is following, and with the prevailing pressure distribution. This point X (located in mountainous country as it is in this case) would, if plotted on a chart, indicate the least safe height to maintain by altimeter over that part of the route in case of misty weather or fog. The pilot could then see at once, without having to make any calculations, his exact height.

Pressure decreases at an average of 1 millibar for every 30 feet of altitude, and some of the depressions passing over the British Isles give a difference on the surface of 30 to 40 millibars in 300 miles. This means that an aircraft maintaining a height of 2,000 feet by altimeter on a flight from South to North would, on nearing its destination, actually be at an altitude 900 to 1,200 feet less than indicated. Of course, these are extreme conditions, but they show the necessity of very carefully taking into consideration the vertical distribution.

Whilst realising also that pressure is constantly changing—extremely rapidly sometimes—it would be easy to show such a change or forecast change of pressure by indicating the direction and velocity of the isobars on the plan by means of arrows.

W. E. A. DUFF.

Rugby.

POLAND AND BRITAIN

Comment on Col. Smallwood's Article

MAY I be permitted to comment on Col. Smallwood's recent article in *Flight* on the inaugural London-Warsaw air service?

These comments do not concern the flight itself but the remarks made concerning the education of Polish opinion and ideas, as stated at some length therein. It must obviously be difficult for a foreigner to Poland (or any other country) to give a really representative viewpoint of the true situation in that country, and a Polish friend of mine, having read the article, expressed disagreement with some of the statements made. He has written as follows:

> "I have a few remarks concerning the article written by Col. Smallwood, which I think might be of some interest.
>
> "The author's suggestion that the German language should be used in popularising British ideas in Poland sounds a little paradoxical. Actually the knowledge of German is common only in certain classes of town dwellers (comparatively few in number and found especially in the south and west of Poland). For the overwhelming majority German is no better, say, than English. The best propaganda could only be carried out effectively in the mother tongue.
>
> "Why not give the news in Polish on certain medium waves?"

Anything which promotes a better understanding between peoples is a solid contribution to real peace, and this understanding can only come about by the free exchange of opinions—the foreigner's no less than our own.

D. F. GEORGE.

Hutton, Essex.

BLIND APPROACH

Future Developments—and a Suggestion

AFTER reading the article in the issue of May 25 by Mr. A. Robert Edis, I feel gratified to have roused at least some interest and discussion in this subject. I am afraid, however, that, as feared by Mr. Edis, he has been rather led astray by his lack of technical knowledge. The major difficulty of his suggestion is the necessity for simultaneous transmission and reception on the aircraft. Another difficulty is that of mounting a large map together with very delicate instruments in a cockpit.

My own feeling in this matter of blind approach is that so far as the final approach and landing are concerned the existing radio guides are sufficient to cope with the minimum visibilities in which it is possible to land aircraft having present minimum speeds, and that the next advance must be in the way of reducing these speeds.

Rather than introduce more complex apparatus along the lines of present radio approach guides, I feel that effort would better be directed to providing "direct vision," which would appear to be possible by an arrangement of a television camera working with infra-red rays coupled directly to a cathode-ray tube receiver similar to that used for television reception.

It is patent that the commercial reward which would result from the development of such a scheme would be in no way commensurate with the expense of such development. However, if, as has been done in the past with such things as helicopters, calculating machines and chronometers, some form of substantial prize could be offered for the production of a satisfactory instantaneous method of direct vision in fog, many technicians with the necessary knowledge would no doubt endeavour to produce such a device.

FRANK BRENT.

Croydon Aerodrome.

"Flight" photograph.

A section of the machine park, showing most of the aircraft.

A PARLIAMENTARY PARTY

Superb Exhibition of R.A.F. Skill and Equipment : "New and Experimental" Fly-Past : Two Secret Types.

MEMBERS of the House of Lords and the House of Commons, High Commissioners for the Dominions and Dominion Liaison Officers, together with officials from the Board of Admiralty, Army Council, Air Council, Government Departments, and Air Ministry Committees, witnessed at Northolt last Tuesday week what was perhaps the most convincing display of Service flying ever staged. They watched the world's finest standard military aircraft demonstrating their functions and performance, inspected an assortment of semi-secret prototypes and saw a tantalisingly hasty fly-past by two unmentionable machines which are still secret.

The machine park, first attraction after fourteen coaches had discharged their loads of legislators, contained three Hurricanes, three Spitfires, three Gladiators, a Hudson, three Hampdens, three Whitleys, three Wellingtons, three Blenheims, three Battles, and examples of the Henley, Harvard, Tutor, Oxford, Anson, Walrus, Beaufort, Defiant, Roc, Skua, and Master (but no Lysander!), while searchlights, anti-aircraft guns, a balloon, a Link trainer, and other equipment was available for inspection.

While R.A.F. officers were still being plied with questions (any normal schoolboy would not have deigned to answer many of these, though some displayed encouraging intelligence) a wing of twenty-four Vickers Wellington bombers boomed over at a menacing height to give the first massed demonstration of these substantial geodetic-built craft, which have a longer range than any other aircraft in the Service.

Massed Fighters

Some minutes later the Wellingtons were followed by two fighter wings embodying six squadrons of Hurricanes and one of Spitfires, the first group flying in wing formation, and the second in diamond formation. Some people remarked how pretty they looked, while others tried to multiply 63 by 8 and the result by 1,200 to arrive at an answer in rounds-per-minute. Later one Hurricane squadron detached itself from the formation to land in impeccable style.

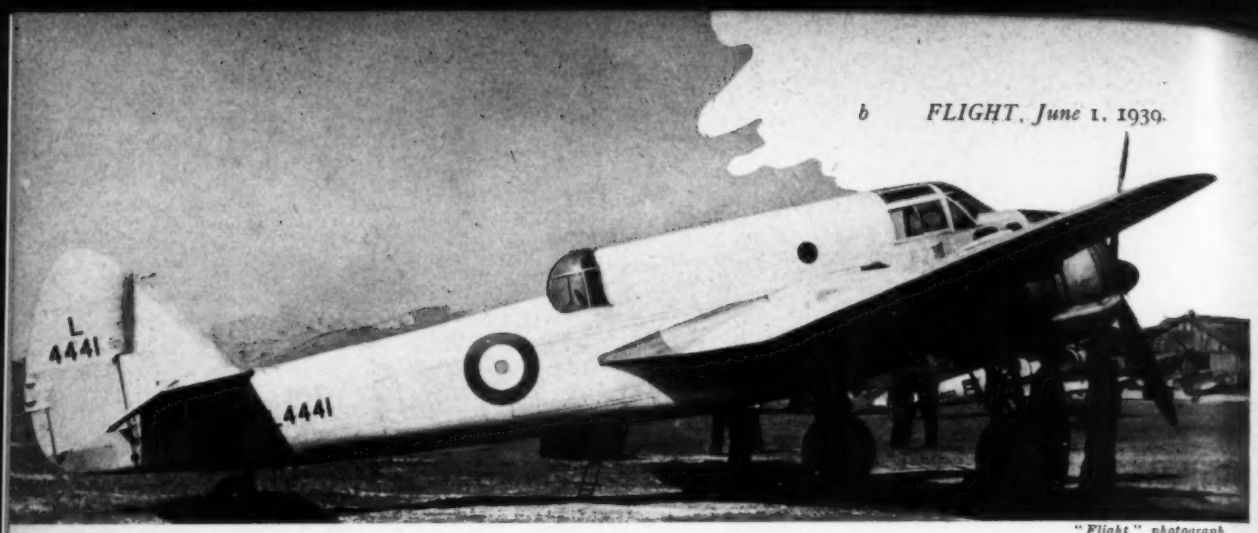
The Henley and semi-camouflaged Harvard collaborated in demonstrating how R.A.F. pilots can make stern attacks on an "off-set" drogue target without exposing the towing machine to any risks. We may be wrong, but the Henley pilot seemed to have a nice sense of humour. He kept his 285-m.p.h. "tug" sailing along effortlessly and quietly at 200-and-something m.p.h., while the Harvard (which, despite its shocking noise, is a very sound trainer and has a speed about 70 m.p.h. lower than that of the Henley) came howling along from astern apparently straining every rivet to catch up with that tantalising, fluttering drogue, like a terrier dragging at his leash to get at a cat.

We hear a good deal about the specialised dive bombers of other nations, and are inclined to discount the capabilities of our own machines in making diving attacks. The dive-bombing demonstrations by Battles were therefore, specially welcome. These were combined with low bombing, during which it was possible to gauge how soon the pilot must release his bombs before reaching the target.

Approaching in echelon at about 2,800ft., the machines of the dive-bombing flights peeled off in the recognised

The three Sunderlands from Pembroke Dock changing formation after their fly-past.

"Flight" photograph



"Flight" photograph.

The Bristol Beaufort reconnaissance torpedo bomber (two Bristol Taurus), which was on view but did not take part in the fly-past.

manner, whereupon the pilots did an aileron turn on to the target, "stuffing it down" at 75-80 deg. and releasing their practice bombs at 800ft. In view of the fact that the Battles must have been doing about 300 m.p.h., and considering the surprising sharpness of the pull-out, the crew must have come quite near to "blacking out." And it was no mere demonstration of diving; every bomb fell close to the target, which was only a few hundred yards from the visitors' enclosure. There was one direct hit. Sqn. Ldr. Donaldson, the commentator, emphasised the fact that the pilots were not specially selected and that the bombing was of average R.A.F. standard. He said that any bomb of over 100 lb. dropping within 50 yards would be just as good as a direct hit.

Flight Aerobatics

Three camouflaged Gladiators combined to give one of those displays of aerobatics for which the R.A.F. has become famous even among nations who have formed special "stunt" squadrons. They made their bow with a rocket loop after a dive at about 300 m.p.h., following it with a normal loop. During their half-rolls "off the top" (at right angles to the original path of the loop) the flank men were noticeably toed in to prevent their being thrown out of formation by centrifugal force. A loop in echelon was followed by the more difficult line astern loop, the machines regaining "vic" formation on the way up in another loop. Upward rolls, explained the most helpful, if sometimes technically inaccurate, commentator, were started at a speed of about 350 m.p.h.

Everyone gave the Gladiators full marks. Let us hope that some of these machines may long be retained in the Service if only for exhibition purposes.

After the Gladiators' show, straightforward formation flying by three R.A.F. Volunteer Reserve pilots on Hurricanes was, perhaps, not generally appreciated, though those who watched it closely must agree that it did the young pilots great credit, particularly as they had had only eight weeks on Hurricanes and in view of the fact that one was flying with a stiff aileron.

Considering that one heard at least six top speeds quoted for the Supermarine Spitfire (some observations on performance figures appears elsewhere in this issue), it was comforting to be shown conclusively that, whatever the precise figure, the machine is extremely fast. This was demonstrated when one Spitfire, loitering at 80-90 m.p.h. with wheels and flaps lowered, was passed on a rather lower level by a second machine which must have been travelling at at least 380 m.p.h., having benefited from a shallow dive. The speed exhibitionist zoomed at least 3,500ft. after crossing the aerodrome, so far as one could gauge, in just over five seconds.

Three Short Sunderland flying-boats approaching the aerodrome in line astern at what would normally have been a very naughty height brought visitors to their feet. The majesty of their passing will not soon be forgotten. Immediately after crossing the guests' enclosure these twenty-odd-ton monsters formed into "vic" and sailed away home to Pembroke Dock.

The Hurricanes go from strength to strength. An exhibition of formation flying by a squadron was perfection itself and was appreciated all the more for the relay R/T orders from the squadron leader. Line abreast, squadron "vic," arrow, flights astern, and echelon formations were all demonstrated, and the show concluded with a peel-off and dive past from an echelon formation. At one time there was a curling snake of diving Hurricanes coming straight for the aerodrome.

The penultimate item was a take-off and fly-past by the following types, in the order given: Supermarine Walrus spotter-reconnaissance amphibian; Armstrong-Whitworth Whitley III bomber; Vickers Wellington I bomber; Bristol Blenheim Mark IV bomber and reconnaissance machine; Phillips and Powis Master I (prototype) two-seater advanced trainer; Lockheed Hudson reconnaissance bomber; Blackburn Skua I fleet fighter dive bomber; Blackburn Roc I two-seater fleet fighter; Boulton Paul Defiant I two-seater fighter; and Supermarine Spitfire I single-seater fighter. Subsequently a Horice Farman biplane with a 70 h.p. Renault engine took off, made a circuit and landed.

The Walrus dived past in sporting fashion with its characteristic cacophonous crackle, which is due to the stub exhaust pipes.

It was announced that the Whitley was powered with Rolls-Royce Merlin engines, though actually a machine of this type was not present, the one taking part in the fly-past being a standard Mark III model with Tiger VIIIs. While this machine was parked

Some interested visitors, among whom will be recognised Marshals of the Royal Air Force Lord Trenchard and Sir John Salmond.

"Flight" photograph.

Both two-seater fighters built by Boulton Paul and equipped with multi-gun power-operated turrets made by the same company, the Defiant (top) and the Blackburn-designed Roc are in production respectively for Home Defence and Fleet Air Arm use. The Defiant had a Rolls-Royce Merlin and the Roc a Bristol Perseus.

"Flight" photographs.

there was considerable interest in its "dustbin" turret, which was shown extended, complete with twin Browning guns.

The Wellington, described as "the longest-range bomber in the R.A.F.," had a camera gun installed at the muzzle end of two dummy wooden guns protruding from the rear turret. Parliamentary visitors were obviously impressed by the fact that the Wellington can carry a worthwhile bomb load for a range of 3,240 miles, and that it has five machine guns to hit back at any fighters which may attack it *en route*.

The long-nosed Blenheim (Mark IV) did an outstandingly fine zoom after its dive past at something like 300 m.p.h.

A dummy turret of surprisingly large dimensions was fitted well back on the fuselage of the Lockheed Hudson, which was also the object of much Parliamentary attention. In the park its bomb doors were shown open, revealing the capacious ventral bomb cell.

It was unfortunate that a production model Miles Master was not available, as in this machine the power plant installation and radiator housing differ from the prototype.

The Skua dive bomber fighter did not use its flaps in the dive, though its sister machine, the Roc fighter, dived for the aerodrome with these rather remarkable air brakes applied. The pilot raised them at the bottom of his dive and did a steep zoom.

Like the Roc, the Defiant was flying with its full complement of guns in its power-driven Boulton Paul turret, which has peculiar fairing arrangements.

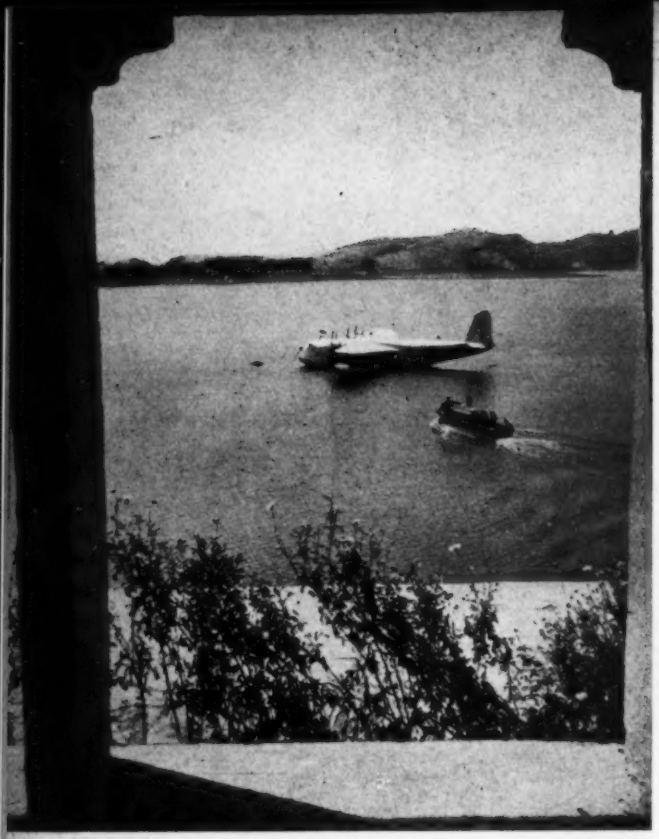
The Spitfire was of the latest type with three-bladed variable-pitch airscrew. Its take-off is noticeably improved in comparison with the earlier fixed-pitch type.

Nevertheless, the "fastest time of the day" was not put up by the Spitfire, but by a secret twin-engined machine which streaked over from the west. This was followed by a second type, which was larger and slower. It would be idle to pretend that *Flight*, and, for that matter, hundreds of people in this country, are not aware of the precise identity of these machines, though further comment is impossible for the time being.

A lunch worthy of the occasion was preceded by a demonstration of a barrage balloon, and was made all the more pleasant by the strains of the Royal Air Force Band which were wafted into the marquee.

Air chiefs past and present: Marshal of the Royal Air Force Lord Trenchard, First Chief of the Air Staff, with Air Chief Marshal Sir Cyril Newall, the present chief of the Air Staff. On the right are Air Vice Marshal R. Williams and Group Capt. F. H. McNamara, the Australian Liaison Officer.

"Flight" photographs.



OVERLAND FLYING-BOAT BASE: The Qantas Empire Airways boat *Cooee* at her moorings on Raj Samand reservoir, Udaipur, India, with a launch taking out the passengers.

Invisible Assets

I KNOW nothing whatever of stocks and shares, and the prices announced a week or two ago for the buying up of the Imperial Airways and British Airways shares, preparatory to the merger, were entirely meaningless to me In fact, in my ignorance of such matters, I always feel that it is a particularly stupid thing that (apparently) the happiness and prosperity of the human race should be in the hands of a comparative few go-getters who are buying and selling scraps of paper either on Wall Street or in the London Stock Exchange. Presumably, the buyings and sellings mirror the state of the market, but these people, by their whimsical efforts, seem to be able to produce famines in Tierra del Fuego, a shortage of lamp oil in China, or a vast over-production of coffee which has forthwith to be used to stoke railway trains or to be just poured into the sea.

Presumably, the ingenious individuals who worked out the price of the two airline companies' shares knew what they were up to, but surely no airline company can possibly be fairly valued at any time. It is no use counting the money in the bank (if any), judging the selling price of a fleet of machines, assessing the value of the equipment in a maintenance department, or, even, deciding that a name is worth a few thousand pounds. Practically all the assets of any airline company—and, for that matter, the majority of other transport concerns—are entirely invisible.

Nowadays it costs a simply tremendous amount of money to run an airline properly, and the results of this expenditure may not be apparent for the years during which regularity is good and safety reaches 100 per cent. Only afterwards can the work which has been done be properly assessed. Money is spent in hundreds of thousands always for to-morrow; the returns to-day are negligible, and by its very nature the airline company cannot even realise solid operational assets like signal boxes and railway embankments. The signal boxes and the embankments are quite invisible and are kept in position only by perfect organisation and an operational department which works as a team. Even the experience of the different members of this department is worth only a very small proportion of the plain cash which has been spent in making an airline company into a going concern.

Topics of the Day

SUBSIDIES—GOOD and BAD

"Indicator" on Modern Airline Operation and the Club Position

If practically any one of our smaller internal airline companies faded out to-day there would be absolutely nothing to show for it in tangible assets, yet nobody is going to tell me that so much money has been spent for no purpose.

The fact of the matter is that airline operation is becoming more expensive every year. In the ordinary way the passengers' fares on the different services do not even pay the salaries of the traffic clerks and the less important members of the operations department. The time has come when regular high-speed airline operation is only possible as a national concern.

At present it is hardly possible to answer the question of whether air transport is worth all the money which has been, is being, and will be put into it. In ten, twenty, or even fifty years' time we may know. Like the assets of the individual airline companies, the returns are invisible and indirect. The thousands of people who weekly make use of the airlines for the carriage of mails and freight, and the hundreds who make use of them for personal conveyance, are only a comparatively small proportion of those who eventually gain from high-speed communications.

Maybe we should all be happier in our caves and treetops, but the organisation of civilisation is such that only a vast cataclysm or a large-scale war can put us back into the Elysian fields, where we shall have toothache without a dentist or even an aspirin to relieve it. We can only go on and hope that it will sort itself out. And, while we are supposedly civilised, the faster the communications the more efficient is the general organisation.

No Longer Private

IN the meantime practically every bit of flying that is done over the whole world is subsidised in one way or another. That, on the face of it, is a bad thing, but apparently inevitable. I do, at times, feel justifiably annoyed, for instance, that Government support has at any time been necessary for club flying, since it leaves each club in the position of a spoon-fed disorganisation.

During the period before the institution of the Civil Air Guard scheme all the clubs were complaining that they could not keep going, yet if they had definitely known that no more money was forthcoming, the better and bigger ones, at least, would surely have made a more vigorous effort to run their concerns on a semi-self-supporting basis. In the halycon years of 1925-1928 enthusiasm was at its peak, and it seemed then as if within a short time, even a small subsidy would become unnecessary.

Because of spoon-feeding, the clubs have never had anything much to fight for, and, consequently, have never made much attempt to offer real flying facilities even for those who could afford them. It would not be an exaggeration to say that thousands of useful members have simply left the clubs because, after they have obtained their "A" licenses, secretaries and committees have done just nothing to encourage them. If the weather was good, if machines were available, if the secretary was not suffering from a liver attack, and if the chief instructor had not had a night out, the reasonably experienced member was permitted to take a machine away to some nearby aerodrome—provided that it was returned almost at once.

To put it plainly, in ten years the clubs have done practically nothing to help themselves, except to clamour for

(*Concluded on page* 566.)

NORMALISING the STALL

An Aerobatic Trainer : Some Air Impressions of the Two-seater Tipsy with Built-in Slots

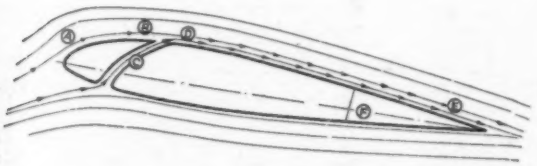
The Tipsy two-seater in its latest form — though without the new louvres at the wing tips.

IT seems that the development of fixed non-drag slots, or louvres, by the Lockheed Company for their Fourteen may be a very much more important one than was originally imagined. There is no patent on the scheme, and quite a few American manufacturers of light aeroplanes are building these slots into their latest types. Apart from those on the British Airways Fourteens, the first to be seen in this country are in the wing of a Tipsy two-seater. This is one of the several minor improvements which have been made to this machine since the British prototype was first flown.

Eventually designers may produce the completely stall-proof aeroplane, but in the meantime a great deal has been done if means can be found of retaining lateral control at the stall. And that is what the new slots certainly do. Those who have flown the modified Fourteens are enthusiastic about the improvement to this machine's characteristics. No one claims that the stalling speed is appreciably altered or that the manner of the stall is changed, but the pilot retains full lateral control beyond the point at which the machine would normally be past immediate salvation.

The same thing applies to the Tipsy. It is possible that the actual stalling speed is slightly lower with the slots, but this is not noticeable. From a very gentle stall it sinks quite stably, but from a more violent stall one wing or the other drops. In its unslotted form the wing cannot be pulled up until a little speed has been automatically gained after lift has disappeared. With the new slots, however, it is possible to fly indefinitely with the stick kept right back, holding a recurrent falling-away to one side or the other with ailerons and rudder. At and below the stalling speed there is, in fact, quite a useful degree of aileron control, though a fair amount of rudder must be applied to counteract slow-speed drag.

Although full rudder movement is usually considered to be necessary to institute a spin with practically any machine, the fact remains that such a manœuvre can very often be started on aileron drag alone. In other words, if, at the stall, one wing drops, the instinctive aileron recovery movement may precipitate a spin, or, alternatively, a violent cart-wheel into the ground if the stall occurs during the last phases of the approach. The louvres, so far as one can make out in experiments at a safe height, entirely prevent this possibility.



The diagrammatic representation of the stalled airflow over a louvred wing section—actually that of the Lockheed Fourteen. At "A" the air is moving at high velocity ; at "B" would normally be slowing down ; at "D" the air emerging from "C" increases the velocity, giving ample flow for aileron control at "E."

No degree of violence in aileron movement, with the stick held right back, could, without rudder, be made to cause even a stalled spiral, let alone a spin.

Otherwise the characteristics remain unaltered, and if the slots make any difference to the maximum speed this is hardly measurable. In the case of the Lockheed Fourteen, which has a top speed of 245 m.p.h., only a 2 m.p.h.. reduction was recorded, so that, proportionately, the Tipsy's speed should be reduced by 1 m.p.h.

After duly discovering the effects of the slots at low speeds, I did two or three turns of a spin in each direction. In the early stages, at least, recovery with opposite rudder is virtually instantaneous, the machine making no more than a quarter of a turn after correction has been applied. Apparently, after five turns or so the spin, as in the case of all low-wing machines, goes flatter, but recovery continues to be normal, and I believe that Mr. Falk, while doing the spinning tests for the Air Registration Board, did as many as fifteen turns without discovering any queerity. Martlesham pilots—the original aerobatic C. of A. was obtained before the new system was brought into force—were satisfied with four turns to the left and right.

The rate of rotation is moderately fast, but, at least during the preliminary turns, the nose is well down and the manœuvre appears to be very normal. Although, without corrective aileron, the final stall can be fairly pronounced, the Tipsy does not start a spin readily, even with the application of full rudder, and my first attempt resulted in no more than a tight spiral from which the machine recovered as soon as the elevator was allowed to return to a neutral position.

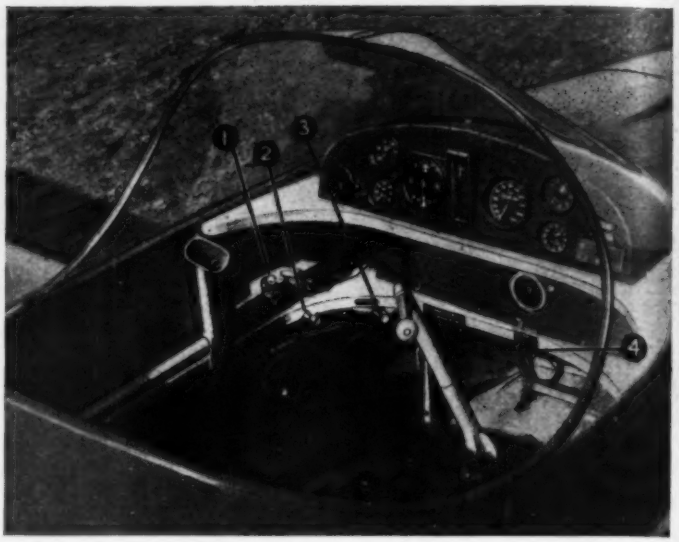
Since I first flew the prototype last year a number of changes have been made to details. The flap control, for instance, is now a straightforward two-position lever immediately below the throttle control, while the trimming lever has a larger number of setting positions. The comfort of the instructor,

TIPSY TWO-SEATER

Engine - 62 h.p. Walter Mikron.

Span	31ft. 2in.
Length	22ft.
Weight empty	624 lb.
All-up weight (normal)	1,073 lb.
All-up weight (maximum)	1,200 lb.
All-up weight (aerobatic)	1,045 lb.
Cruising speed	100 m.p.h.
Maximum speed	110 m.p.h.
Stalling speed	35 m.p.h.
Initial rate of climb	500ft./min.
Service ceiling	15,000ft.
Range	400 miles
Price	£550

Makers : Tipsy Aircraft Co. Ltd., London Air Park, Hanworth, Middx.



The present cockpit layout of the Tipsy. The controls are: (1) Throttle and mixture; (2) Flaps; (3) Trimming; and (4) Fuel tap. The control column is shown with its instructional extension. In the centre, below the dashboard, will be seen the direct-acting fuel-gauge.

who sits on the right and slightly aft of the pupil, has also been specially considered; his own throttle, which is reached behind the pupil's back, is in the new position, and very shortly the works at Slough should have developed a windscreen extension which will reduce the draught. A simplified screen arrangement is also being experimented with; from the very start the idea has been to provide cabin comfort—as nearly as is possible with an open cockpit—and no goggles are necessary.

Following minor criticisms by the Martlesham test pilots, who found that there was insufficient rudder area and movement for such manœuvres as slow rolling and side-slipping, area and movement have now been increased and are ample for all normal purposes. Low-wing aeroplanes are not meant to be slipped, but it is quite practicable to do one of the crab variety if a little height must be lost during an approach. Actually, the best way of making an approach with the Tipsy is to come in in the conventional "right-angle" manner, turning into wind with height to spare, and applying the somewhat diminutive flaps to do the work of the side-slip previously used with the old type of training biplane. Incidentally, the comparative smallness of the flaps is a good thing, since pupils can more easily be trained to use these items of equipment. Later on, larger areas of flap will not be so surprising.

For those who appreciate flying as flying, by far the most attractive features of the Tipsy are its controls. The ailerons are light, but not too light, and absolutely positive, so that in the course of a normal cross-country flight it is difficult to resist the temptation to proceed in a series of steep turns, or even, if Sutton harness is fitted and no loose bits are lying around, of slow rolls. In the ordinary way one thinks nothing of tipping the machine up vertically in order to have a look at something down below. Aerobatics, even of the simpler and more sedate kind, are almost too easy, and the three controls are harmonised in just the right proportion—the ailerons being lightest, and the elevator and rudder following.

Apparently, instructors and others have complained that the controls are too light and positive for instructional purposes. This seems to me to be plain conservative nonsense. We are much too accustomed nowadays to soggy controls in the American style, and, apart from genuine aerobatic trainers, small machines with really effective controls are few and far between. Even if a pupil *does* spend half an hour more in learning not to over-correct, and to handle the controls as they should be handled, this is time well spent, since he may not always be flying a soft and stable aeroplane. The Tipsy is not stable in the present-day sense of the word, though in smooth air it will, if correctly trimmed and with the right amount of fuel in the tank, fly hands and feet off. At all times it is possible to fly without using the rudder—which is all that can be asked.

As if to make up for any possible additional tuition time in actually learning to fly straight and level and to make correct turns, the Tipsy must be the easiest machine in the world to land. With limited elevator control and a small ground angle, it is virtually impossible to make a bad landing. Once the somewhat flat approach and the technique of flap operation have been mastered, the still-air landing speed of 35 m.p.h. means that the Tipsy can be put down within the smallest possible space. The machine is now available with a Fairey metal propeller, and the machine I flew last week was so fitted. Possibly the cruising speed is slightly reduced, but the take-off acceleration is very marked, and the climb quite phenomenal at 50-55 m.p.h. on the A.S.I.

The Tipsy works on the Slough Trading Estate have long since settled down to production under the control of Mr. Gilbey, and, even with the present accommodation, it is possible for the works to turn machines out at the rate of two a week. At the moment the engine being fitted is the Czecho-slovakian Walter Mikron, but very shortly S. E. Oppermann, Ltd., who have the manufacturing licence over here, should be in production with the British version.

H.A.T.

TOPICS of the DAY

(*Concluded from p. 564d*).

more money out of the taxpayers' pockets. I am not suggesting that light aeroplanes are inevitably useful means of transport, but I am saying that during the summer months they can be very helpful devices, and a relief, at least, from road congestion.

One can hardly blame the pioneer members for losing interest when machines were only offered them for long cross-country flights through the apparent magnanimity of the secretary. The paying club member had a right to feel that the machines were his so long as any were available—and they usually were, in large quantities, until this mass training was started. Now, of course, one is lucky to obtain an aeroplane to do three or four aerodrome circuits just for the purpose of keeping one's eye and hand in.

The C.A.G. scheme is essentially a good and necessary thing, but the clubs have now lost all chance of ever getting back to their original position as purveyors of aeroplanes on hire. The mass training system should, perhaps, have been instituted quite separately, leaving at least a dozen clubs to act as advanced training grounds for the more experienced amateurs, who now have nowhere to go at all. As I have said, the clubs, as clubs, are finished. They are now merely Government training centres dependent entirely on the whims and wishes of the Air Ministry. If the latter stopped payment, every one of them would just collapse and there would be no more flying.

INDICATOR.

PS.—If somebody will lend me a Link Trainer (with or without an instructor) I will happily pay him ten shillings an hour for its use. The Reserve schools do not appear to be making any great use of theirs and I want to practice blind flying.

Power-Merlin Channel Record

ALL records for crossing the English Channel by sea between Hythe, Southampton, and Cherbourg were broken recently by Mr. Hubert Scott-Paine with one of his latest-type motor torpedo boats, powered by three 1,100 h.p. Rolls-Royce Power-Merlin units.

The crossing between The Needles and Cherbourg breakwater—a distance of 70 statute miles—was covered at an average speed of 42 knots or 48 m.p.h. The outward run occupied 1 hr. 26 min., while the homeward passage was made in 1 hr. 27½ min.

On the outward run the sea was calm, but, on the other hand, visibility was reduced to a bare four miles. For the return run the M.T.B. was faced with a confused oily swell for the first half of the crossing, but no pounding or slapping was noticed, simply a rather quick pitch—this in spite of a speed of 41 knots.

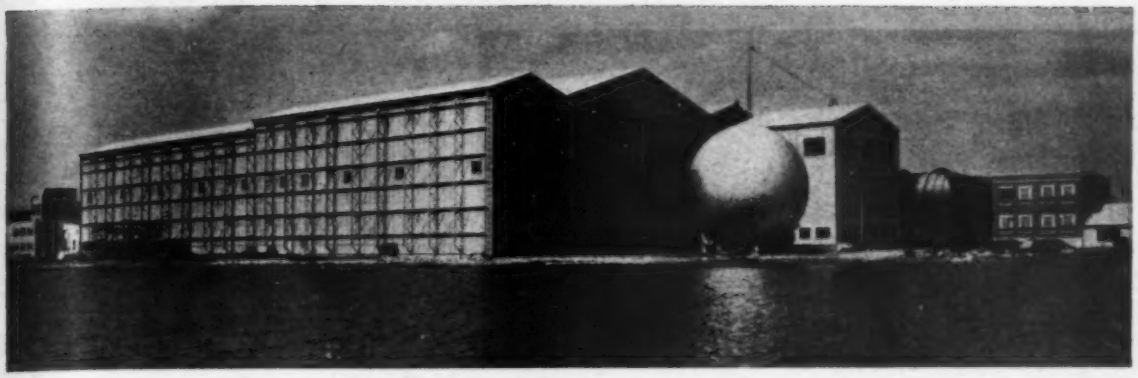


Fig. 1. A "corner in wind tunnels": The large building on the left contains the full-size tunnel at Langley Field. The new 12ft. free-flight tunnel is inside the steel sphere seen at the end of it, and a corner of one of the high-speed tunnels can be discerned beyond.

RESEARCH—ANCIENT and MODERN

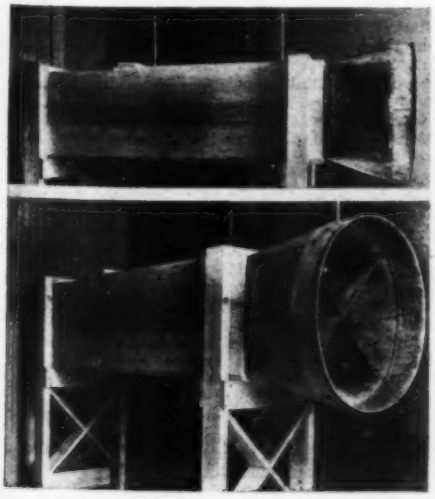
From the Wright Brothers to the N.A.C.A. : 27 m.p.h. to 500 m.p.h. : Dr. Lewis's Wilbur Wright Lecture

THERE have been many Wilbur Wright Memorial Lectures at the Royal Aeronautical Society. In fact, this year's was the 27th. But there have been few which equalled in general interest that given last Thursday by Dr. George W. Lewis, Director of Aeronautical Research, National Advisory Committee-for Aeronautics. It may be that the juxtaposition of the oldest and most modern research equipment helped to create this impression. And it did give an opportunity to admire and marvel at the foresight and thoroughness of the Wright Brothers who, as the lecturer pointed out, included in their research programme all but one of the important variables *in* 1901!

Dr. Lewis dealt in his lecture with the Wright Brothers' wind tunnel and its equipment and results; with the new 8ft. 500 m.p.h. tunnel; with the new low-turbulence tunnel; with the new gust tunnel; with the 5ft. free-flight tunnel; and with the latest N.A.C.A. 12ft. diameter free-flight tunnel contained in a spherical steel shell.

Describing the Wright Brothers' wind tunnel, the lecturer explained that it was 5ft. long, with a square test section of 22in. sides. The speed attained was 27 m.p.h., or 40ft./sec. The original plottings of profile and plan form of some of the aerofoils tested are reproduced in Fig. 4. Dr. Lewis called attention to the fact that models 7, 8 and 9 were plates with camber forming part of arcs of circles, the camber being varied systematically; while models 10, 11 and 12 had the same amounts of camber, but had the maximum camber placed farther forward. The aspect ratio was 6: 1 (1in. chord, 6in. span), which is now standard in research laboratories. In Fig. 5 is shown, from original sketch and photograph, the lift-measuring balance, and in Fig. 6, the balance for measuring D/L. This latter balance measured directly the ratio of drag to lift as the tangent of an observed angle, "a method," the lecturer said, "which may appear tempting even now to the wind tunnel investigator, overburdened as he is with the calculation of induced interference effects."

The Wright Brothers measured the lift against a set of resistance plates which had previously been calibrated against the drag of a square flat plate of known area. The drag was measured as a percentage of the lift. Direct measurement of actual forces to be expected on the full-size machine was not made then, but came in 1902, when a glider was built and tested against a wind of known velocity. The weight being



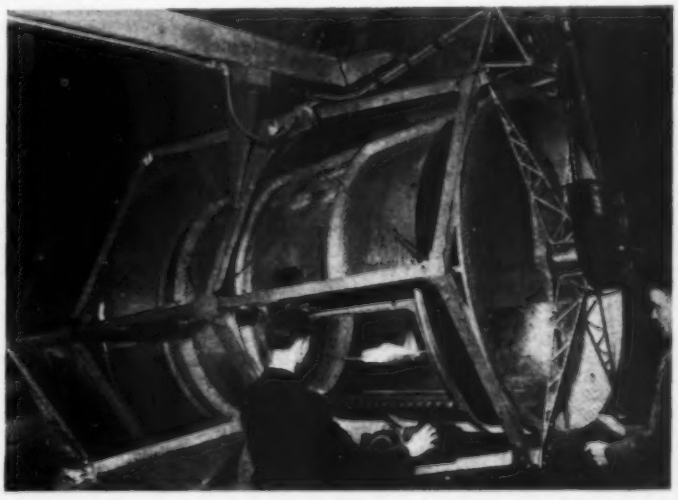
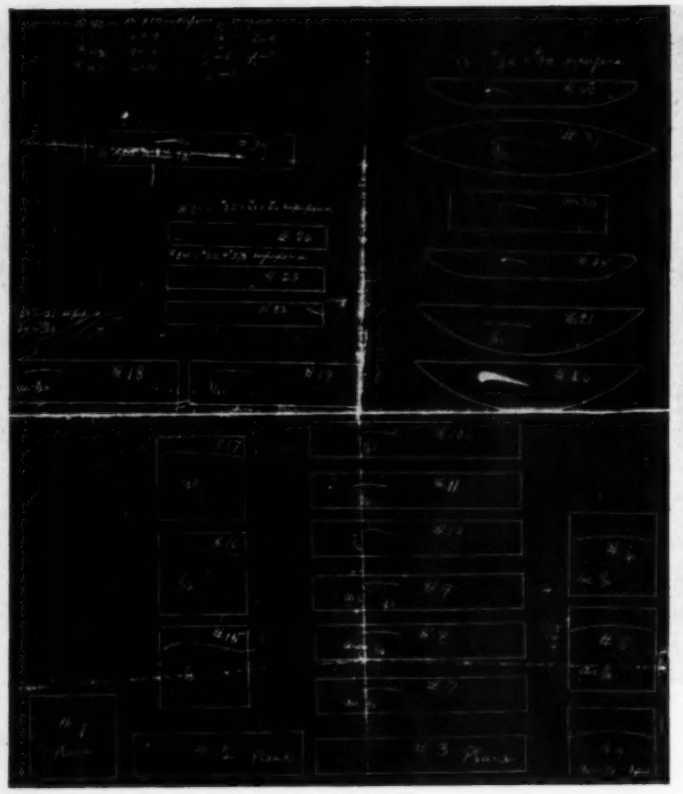


Fig. 2 (left) is a replica of the Wright Brothers' wind tunnel of 1901. In Fig. 3, on the right, is seen the free-flight tunnel in operation. The man in the foreground controls the tilt and air speed, while the model is controlled by the man on the right



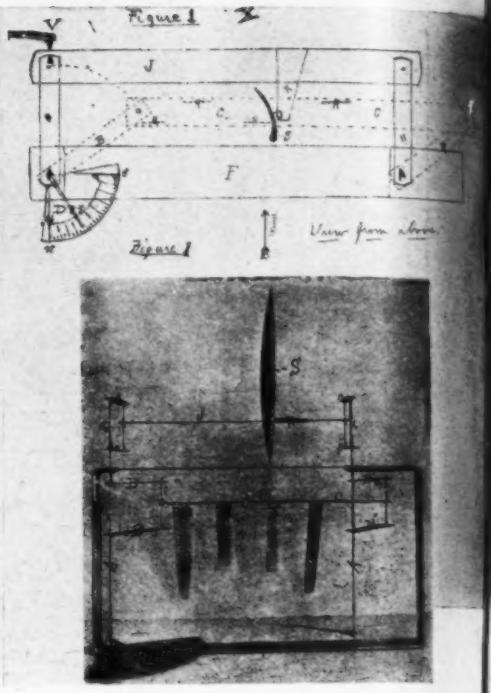


Fig. 4 (left) shows plan forms and sections of wing models tested by the Wright Brothers in 1901. Fig. 5 (above) is a reproduction of an original sketch and photograph of the Wright Brothers' lift-measuring balance of 1901.

known and the angle measurable, the lift and drag forces could be calculated. The relationship between the tunnel tests and glider tests gave the "scale effect," which was assumed by the Wrights to be the same for all their model wings. By these steps they reduced the critical assumptions to one: that the order of merit of the aerofoils tested would not be seriously affected by Reynolds Number, although the absolute values of the coefficients might change.

Another astounding fact was revealed by the lecturer: From their 1901 and 1902 tests the Wright Brothers calculated that the unit drag of a square flat plate of large area was equal to the speed, in m.p.h., multiplied by the coefficient 0.0033. The figure accepted in modern times, based upon a vast amount of research, is 0.00328!

Tunnel Results in 1901

As an example of the sort of results obtained by the Wrights in their works is published Fig. 7, which is reproduced from the 1901 original. Lift is plotted against angle of attack as a percentage of the resistance of a square flat plate, and drag (or drift as it was called in those days) as a percentage of the lift. Dr. Lewis pointed out that in present non-dimensional terms the drag coefficient of a square flat plate is about 1¼, so that the maximum lift coefficients obtained by the Wrights with circular arc aerofoils varied from about 1.3 to about 1.5, values clearly in agreement with modern knowledge of aerofoils. "With this information," Dr. Lewis concluded this section of his lecture, "it is amply evident that the Wright Brothers, through their investigations in 1901, gained a clear physical conception of the behaviour of wings on which to base the design of their successful 'flying machine.'"

Turning to trends of modern development, Dr. Lewis said that this had been mainly towards increase in size and air-speed. He recalled that since its early days the N.A.C.A. had endeavoured to follow the policy of anticipating the future needs of aeroplane design by the construction of wind tunnels having special characteristics. By way of examples he quoted the following equipment at Langley Field: The variable-density wind tunnel; the 20ft. propeller research tunnel; the full-scale tunnel; and the high-speed jet tunnels for aerofoil research under airscrew-operating conditions.

More recently, the lecturer continued, anticipation of further increases in aeroplane performance led to the construction of the 8ft. 500 m.p.h. tunnel, which had been found effective in providing design information for the development of high-speed aeroplanes.

The most recent effort in connection with the policy of the N.A.C.A. was the 19ft. pressure tunnel. Designed in 1937, this tunnel was now being placed in operation. In it large models can be tested at pressures from sub-atmospheric up to several atmospheres, and at airspeeds in excess of 250 m.p.h.

The tendency was for wind tunnels to become more specialised, and Dr. Lewis described three types, each of which had application to a special field of aerodynamics directly related to the fundamental problems of aeroplane design.

Reduction of drag was important to speed, range and efficiency. For the interpretation of wind tunnel results to free atmosphere conditions a helpful simplification resulted from the concept that turbulence in the atmosphere was of such a nature that its effect on the transition from laminar to turbulent flow in the boundary layer might vanish under free flight conditions. Recent investigations had indicated that there might be some possibility of more extensive laminar boundary layers and consequent lower drags. The N.A.C.A. low-turbulence tunnel, designed in accordance with Eastman N. Jacobs' suggestions, was completed in the spring of 1938, and is in many ways the most highly specialised tunnel yet constructed by the N.A.C.A.

The test section is 3ft. by 7.5ft., and is arranged for testing models with a chord of several feet and a span of only 3ft., the flow being essentially two-dimensional. In this tunnel values of the critical Reynolds Number for transition had been found to exceed 6,500,000. The maximum values of the equivalent flat plate Reynolds Number were those given by Professor B. Melvill Jones as approaching 5,000,000. Aerofoils designed to take advantage of true low-drag laminar boundary layers over a major portion of their surfaces showed spectacular results in drag reduction. The lecturer was not able to report results of the latest investigations, but said the American studies were directed towards the actual mechanism of transition under the simplified conditions which appeared susceptible of almost complete experimental control.

In describing the vertical gust tunnel and its working, the lecturer pointed out that these gust loads were the most important conditions for which the structure should be designed because (1) the relative structure weight increased with size, making it necessary to reduce the design loads of large aeroplanes to a minimum; (2) increased size was accompanied by

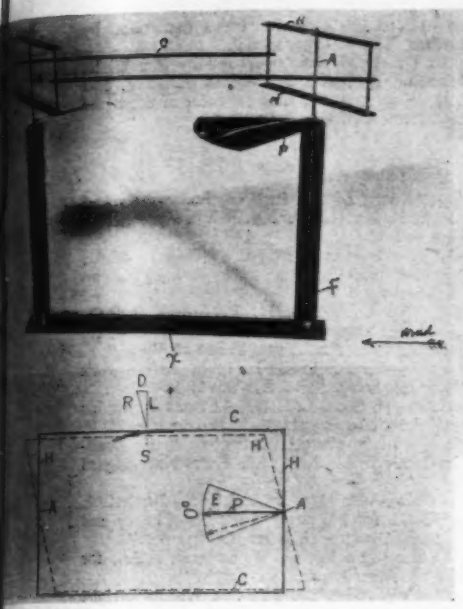


Fig. 6. The drag balance measured drag as a percentage of the lift.

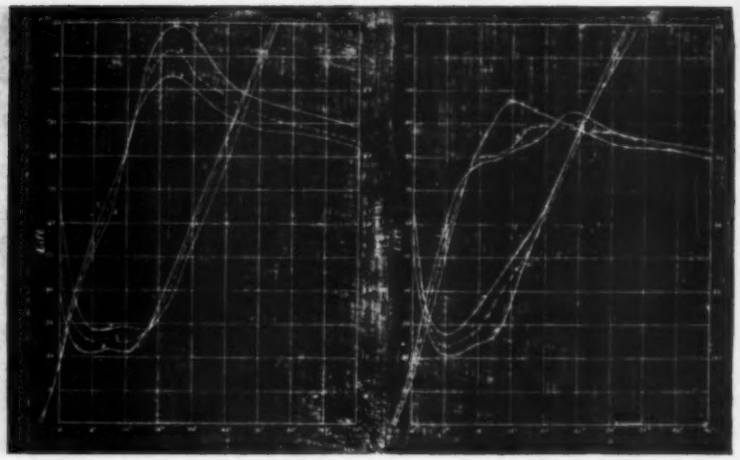


Fig. 7. Lift and drag curves reproduced from the original plots of 1901. Note the familiar shape of the curves. Lift is plotted as a percentage of the resistance of a square flat plate, and drag as a percentage of the lift.

increased wing loading, which increased the gust loads because of the reduced alleviation caused by the motion of the aeroplane; and (3) the gust loads increased directly with the speed of flight.

To measure the accelerations during actual airline operation the N.A.C.A. V-G recorder was produced. This instrument records by means of stylus on a smoked-glass plate acceleration and airspeed simultaneously. These instruments were installed in a number of American airline machines, and up to March 20, 1939, no fewer than 67,300 aeroplane hours of flying time were accumulated. With the aid of these records it had been possible to ascertain that the probable maximum effective gust velocity (based on the sharp-edged gust hypothesis) was 30ft./sec. for an aeroplane having the characteristics of the Boeing 247.

The N.A.C.A. gust tunnel is best described in the lecturer's own words: "It consists simply of an expanding rectangular channel which discharges a current of air in an upward direction. The general layout of the tunnel and associated apparatus is shown in Fig. 8. The air stream is supplied by a large Sirocco blower. The velocity of the jet is controlled through the blower speed, and the velocity distribution is controlled by suitable screening in the mouth of the tunnel. Jets of almost any desired velocity distribution may be created, although attention has thus far been directed only to linear velocity distributions ranging from the uniform distribution with a narrow boundary zone (one-third of the chord of the aeroplane model) to linear gradients in which full velocity is attained in about 16 chord lengths.

"Auxiliary apparatus includes a weight-driven catapult for projecting the model into a free glide at constant speed, a system of rubber strands and burlap screen for catching the model unharmed at the end of its flight, a small automatic recording accelerometer mounted in the model, and cameras for photographing the flight path.

"In operation, the model is projected down a track by the catapult. When flying speed is reached, the model, which has attained its proper trim attitude, takes off. A thrust bar that has been pushing the model at its centre of gravity is automatically retracted to clear the model. At the same time, tiny lamps at the nose and tail of the model are turned on and the accelerometer starts to operate.

"The model glides at constant velocity until it enters the air jet, from which point it moves in accordance with the changing forces imposed upon it. The cameras beside the tunnel photograph the paths of the lamps at the nose and tail of the model. From these photographs, the vertical motion of the centre of gravity and the pitching motion can be evaluated. A revolving shutter, placed in front of the up-path camera, interrupts the light from the nose and tail lamps so that the lamp paths on the photograph appear as dashed lines. From the scale of the photograph and the speed of the shutter, the flight speed of the model prior to its entry into the gust is determined.

"The accelerometer, which is small enough to be housed within the fuselage and light enough (approximately 3½ ounces) for the purpose, is used to provide a direct measure of the vertical acceleration, which would otherwise have to be obtained by the unsatisfactory process involving double differentiation of the flight path. This accelerometer is air-damped and has a high frequency (130 cycles per second) so that rapid changes of acceleration can be measured accurately. The accelerometer record is synchronised with the flight path record by means of a narrow beam of light which is caused to impress a vertical line on the accelerometer film. Since the position of the light beam is known, the position of the model on the flight path is known at an instant of time marked on the accelerometer record.

"After traversing the gust, the model must be arrested or caught without damage. This is accomplished by decelerating the model with a system of closely spaced vertical rubber strands until the momentum is largely, but not entirely, dissipated. At this point the nose of the model, to which is secured a small barbed spear, engages a burlap screen. The residual momentum is sufficient to cause penetration of the spear into the burlap, and the barbs prevent the model from rebounding.

"The model itself may be of a special type depending on the purpose of the test, or it may be a true scaled representation of an actual aeroplane. In the latter case, the mass distribution along only the longitudinal axis is normally to scale, as up to the present time the tests have been concerned only with symmetrical conditions in the vertical plane. Unsymmetrical cases can, however, be investigated. The rigidity of the wings can be controlled within limits, and means have been devised for obtaining measurements of wing deflection on the accelerometer film."

The results obtained, the lecturer thought, showed that the gust tunnel had fully justified itself.

The Free-flight Tunnel

Describing the N.A.C.A. free-flight tunnel the lecturer said: "Fig. 3 shows the present 5-foot diameter tunnel in operation. The tunnel itself has only one unconventional feature. It is suspended on trunnions so that the inclination can be varied from horizontal to about 25 degrees below the horizontal. Air speeds up to 25 feet per second can be attained. As shown in the photograph, two operators are required. The operator beside the tunnel has the task of maintaining the inclination and air speed in proper co-ordination with the gliding characteristics of the model under test. The operator of the model at the end of the tunnel has several functions; first, he must maintain the model laterally in the centre of the tunnel by use of the rudder, to compensate for lack of stability in azimuth; second, he operates the controls on the model in studies of unsteady flight conditions; and third, he observes the general flying and handling characteristics of the model. This last function follows almost automatically from the difficulty encountered in achieving the desired flight conditions."

As a result of the work done with the 5ft. free-flight tunnel,

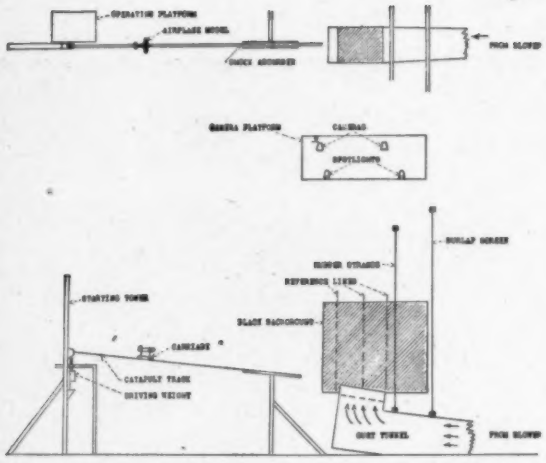


Fig. 8. Diagram of the arrangement of the N.A.C.A. vertical gust tunnel.

the N.A.C.A. decided to build a larger one with a throat diameter of 12ft. This tunnel, which is contained in a large spherical steel shell, can be operated at several atmospheres. It started work a few weeks ago. An exterior view is shown in Fig. 1.

Dr. Lewis showed some extremely interesting films of work in two of the new American tunnels. Slow-motion pictures of the behaviour of a model in the vertical gust tunnel gave an excellent idea of the path followed by the model from the moment of release to the "zoom" caused by the gust and the final "landing" by impaling the spear in the nose of the model in a sheet of burlap.

Fascinating in the extreme was the film of the model in the free-flight tunnel. The idea is, of course, that the model glides in the artificial airstream of the tunnel, the angle of tilt of the latter, as well as the airspeed, being controlled by one man, while another "flies" the model.

A vote of thanks to Dr. Lewis was proposed by Mr. D. R. Pye, Director of Scientific Research at the Air Ministry, and seconded by Mr. H. E. Wimperis, the first Director of Scientific Research and a past-president of the R.Ae.S.

R.Ae.S. Awards

PREVIOUS to the delivery of the lecture the awards and medals of the R.Ae.S. for the past year were presented. They were as follows:—

Silver Medal.—Major R. H. Mayo, O.B.E., M.A., Assoc.M.Inst.C.E., F.R.Ae.S., for his work leading to an advancement in aeronautical design.

Taylor Gold Medal.—To Sqn. Ldr. H. P. Fraser, A.F.C., B.A., A.F.R.Ae.S., for his paper on "High Wing Loading and Some of Its Problems from the Pilot's Point of View."

Wakefield Gold Medal.—To Mr. Leslie L. Irvin for his work on parachute design, which has led towards safety in flying.

Busk Memorial Prize.—To Sqn. Ldr. G. M. Buxton for his paper on "The Development of Sailplanes," and to Mr. H. F. Vessey, A.F.R.Ae.S., for his paper on "Effect of Wing Loading on the Design of Modern Aircraft with Particular Regard to Take-off Problems."

Pilcher Memorial Prize.—To Mr. H. E. H. Rochefort, Wh.Sch., A.C.G.I., D.I.C., for his paper on "The Theory and Practice of Stressed Skin Construction for Aeroplanes."

Usborne Memorial Prize.—To Mr. P. H. Rayner, B.Sc., for his paper on "Notes on Aero Engine Research."

The following awards were also made at the Wilbur Wright Memorial Lecture:—

The Guggenheim Medal was presented to Mr. A. H. R. Fedden, F.R.Ae.S., by Dr. George W. Lewis, F.I.Ae.S., on behalf of the Daniel Guggenheim Fund for Aeronautics.

The Musick Memorial Trophy was presented to Mr. A. Gouge, F.R.Ae.S., by Major Lester Gardner, Hon. F.R.Ae.S., on behalf of the Musick Memorial Award Committee.

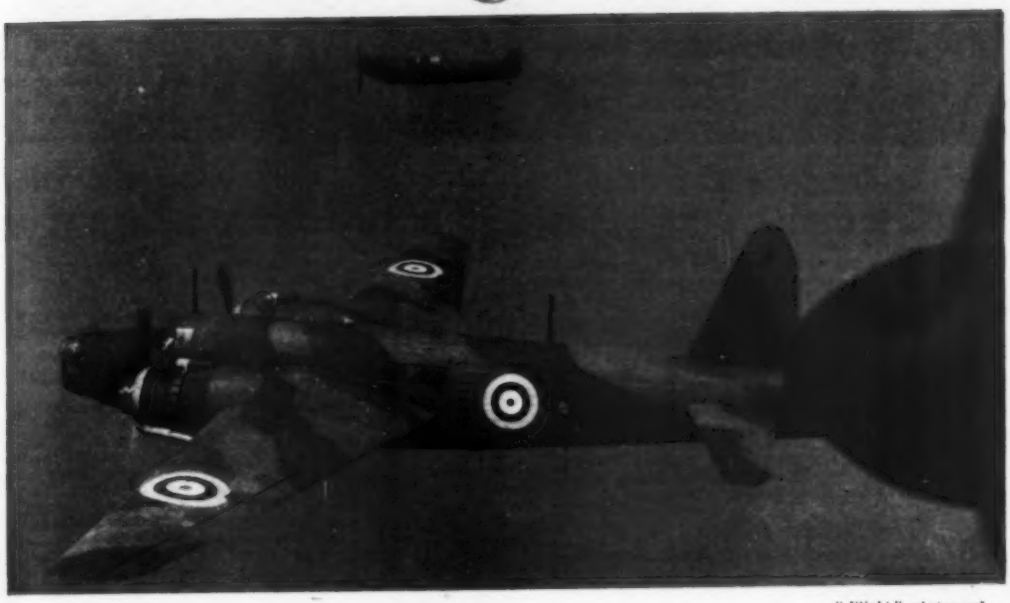
R.Ae.C. AVIATORS' CERTIFICATES

Royal Aero Club Notes are held over owing to the Whitsun holiday; they will appear as usual next week.

No.	Name	Club or School	Date
18,158	Douglas Frederick Howell ...	Bournemouth Flying Club	12.5.39
18,159	Robert Henry Wright-Anderson...	Bournemouth Flying Club	10.5.39
18,160	Peter Basil Rustom	Bournemouth Flying Club	12.5.39
18,161	Sidney Edward Horsfall	Bournemouth Flying Club	10.5.39
18,162	Herbert Charles Gould	Bournemouth Flying Club	5.5.39
18,163	George Charles Hill	Doncaster Aero Club ...	13.5.39
18,164	Sydney Charles George Buszard...	Romford Flying Club ...	10.5.39
18,165	Ernest William Kenton	Newcastle Aero Club ...	13.5.39
18,166	Arthur Bernard Wilkinson ...	University Aero Club ...	3.5.39
18,167	Dennis Charles Lamb	University Aero Club ...	16.5.39
18,168	Adolphus Wilfred Norman ...	Cambridge Aero Club ...	10.5.39
18,169	Duncan Bassett McGill	Liverpool and Dist. Ae. C.	17.5.39
18,170	Victor William Duke South ...	Cambridge Aero Club ...	7.4.39
18,171	William Alfred Dalby	Cambridge Aero Club ...	9.5.39
18,172	Edwin Walter Turner	Cambridge Aero Club ...	6.5.39
18,173	Cardale Frederick Alexander Capon.	Cambridge Aero Club ...	7.5.39
18,174	Geoffrey Harold Wass	Cambridge Aero Club ...	10.5.39
18,175	Hal Bert	Redhill Flying Club ...	16.5.39
18,176	William Francis Machin	Lancashire Aero Club ...	17.5.39
18,177	Albert James Putt	Yapton Aero Club ...	17.5.39
18,178	William Lawton Boon	Lancashire Aero Club ...	11.5.39
18,179	Edward Murtagh Higgins ...	Portsmouth Aero Club ...	16.4.39
18,180	Horace Frank Denham	Portsmouth Aero Club ...	14.5.39
18,181	Winston Claude Wilson	Portsmouth Aero Club ...	17.5.39
18,182	William James Kitchingham Gladwell.	Southend Flying Club ...	18.5.39
18,183	Samuel Herbert Love	Southend Flying Club ...	18.5.39
18,184	Richard Holroyd Harwood ...	York and Leeming F.C....	18.5.39
18,185	Squire Arthur Radcliffe	York and Leeming F.C....	18.5.39
18,186	Roy Norman Elliott	Bournemouth Flying Club	18.5.39
18,187	Edward Giles Plank	Wiltshire Flying Club ...	18.5.39
18,188	Lionel John Anderson	Herts and Essex Aero Club	23.4.39
18,189	Ellis William Cuff Miller	Herts and Essex Aero Club	17.5.39
18,190	Ronald Charles Wingfield ...	Herts and Essex Aero Club	14.5.39
18,191	Alfred William Rigling	Southend Flying Club ...	17.5.39
18,192	Ronald Frederick Barker... ...	Romford Flying Club ...	18.5.39
18,193	Margaret Pearse	Plymouth and Dist. Ae. C.	12.5.39
18,194	Ivan Clarence Rushton	Scottish Flying Club ...	16.5.39
18,195	Douglas Robertson MacGregor ...	Scottish Flying Club ...	15.5.39
18,196	Donald Kenneth Swan	Scottish Flying Club ...	15.5.39
18,197	Walter Humm	Northern Aviation Club...	8.5.39
18,198	Ronald Sebastian Havery ...	Northern Aviation Club...	8.5.39
18,199	Arthur Starkey	Northern Aviation Club...	14.5.39
18,200	Sheila Justyne Blenkerhasett-West.	Portsmouth Aero Club ...	19.5.39
18,201	Nancy Sophia Kendrick	Kent Flying Club ...	16.5.39
18,202	Bryan Hugh Marshall	York and Leeming F.C....	19.5.39
18,203	Denis Wilson	Newcastle Aero Club ...	19.5.39
18,204	William Dick Hawkes	University Aero Club ...	19.5.39
18,205	Joan Renée Cooper	Romford Flying Club ...	20.5.39
18,206	John Rootes	Thanet Aero Club ...	18.5.39
18,207	Peter Charles Gittings	Thanet Aero Club ...	19.5.39
18,208	James Geoffrey Gleadall Butler...	Lincolnshire Aero Club ...	19.5.39
18,209	Albert Edward Austin	Malling Aero Club ...	19.5.39
18,210	William Alastair Foote	Edinburgh Flying Club ...	19.5.39
18,211	Frank Stewart	London Air Park F.C. ...	3.5.39
18,212	William Liddell	North of Ireland Ae. C....	20.5.39
18,213	Margaret Williamson	Ipswich Aero Club ...	14.5.39
18,214	Gwyn Davies	Weston Aero Club ...	20.5.39
18,215	Harold Widlake	Weston Aero Club ...	20.5.39
18,216	Charles Baden Payne	Weston Aero Club ...	20.5.39
18,217	William John Cooke	Weston Aero Club ...	20.5.39
18,218	Harry Gordon Beedle	Weston Aero Club ...	20.5.39
18,219	Ronald Riley	Pedford Aero Club ...	20.5.39
18,220	Maurice Malcolm Elrington ...	Bedford Aero Club ...	21.5.39
18,221	Benjamin Robert Turner... ...	Romford Flying Club ...	19.5.39
18,222	Francis Desmond Carroll ...	Romford Flying Club ...	20.5.39
18,223	Thomas James Hayes	North of Ireland Ae. C....	8.5.39
18,224	George Leslie Sebastian	North of Ireland Ae. C....	13.5.39
18,225	Derek Lennard Clarke	Bristol and Wessex Ae. C.	9.5.39
18,226	Frederick Alexander Puckridge...	Herts and Essex Aero Club	17.5.39
18,227	William Ewart Gladstone Kirkby	Herts and Essex Aero Club	19.5.39
18,228	Geoffrey Victor Pryor	Herts and Essex Aero Club	18.5.39
18,229	James Vernon Wood	Bedford Aero Club ...	22.5.39
18,230	Gwenda Lillian Knight	Bedford Aero Club ...	21.5.39
18,231	Fred Dutson	Bedford Aero Club ...	22.5.39
18,232	Douglas William Pike	Hampshire Aeroplane Club	20.5.39
18,233	John Edward Parker	Hampshire Aeroplane Club	19.5.39
18,234	Stanley Ives Andrews	Southend Flying Club ...	18.5.39
18,235	Ronald Henry Anderson	Southend Flying Club ...	22.5.39
18,236	William Palfrey Brown	Southend Flying Club ...	22.5.39
18,237	Eric Charles Stevens	Southend Flying Club ...	22.5.39
18,238	Stanley Lunt	Midland Aero Club ...	22.5.39
18,239	Ronald Pitcairn Demuth ...	London Air Park F.C. ...	21.5.39
18,240	Derek Charles Hanchett Stamford	Airwork Flying Club ...	20.5.39
18,241	Alfred Charlton Lord	County Flying Club ...	21.5.39
18,242	William Renshaw Dibb	Doncaster Aero Club ...	22.5.39
18,243	James Richard Burton	York and Leeming F.C....	22.5.39
18,244	John Frederick Raw	North of Ireland Ae. C....	20.5.39
18,245	Cyril Paton...	Cinque Ports Flying Club	18.5.39
18,246	John Wilfred Spittlehouse ...	Doncaster Aero Club ...	21.5.39
18,247	Peter Seymour Smith	Bristol and Wessex Ae. C.	22.5.39
18,248	Joseph Chatwin Valentine Jones...	Kent Flying Club ...	16.5.39
18,249	Glyn Gwyn Price Thomas ...	Midland Bank Flying Club	21.5.39
18,250	Ronald Arthur Paddon	Herts and Essex Aero Club	22.5.39
18,251	Gordon Frederick Pearce... ...	Herts and Essex Aero Club	7.5.39
18,252	Alexander Richard Arthur Shephard.	Herts and Essex Aero Club	22.5.39
18,253	Charles Henry Hook	Herts and Essex Aero Club	22.5.39
18,254	Stanley Robert Furnish	Herts and Essex Aero Club	22.5.39
18,255	Douglas William Drummond Faint	Herts and Essex Aero Club	21.5.39
18,256	Stanley Trevallion...	Herts and Essex Aero Club	21.5.39
18,257	John Justinian de Ledesma ...	London Aeroplane Club...	21.5.39
18,258	Richard Hugh Jagger	London Aeroplane Club...	20.5.39
18,259	Rupert Arnold Brabner	London Aeroplane Club...	7.5.39
18,260	John Stone...	London Air Park F.C. ...	23.5.39
18,261	Ronald Edward Haywood ...	Horton Kirby Flying Club	21.5.39

SERVICE AVIATION

Royal Air Force and Official Announcements : Fleet Air Arm News : Military Aviation Abroad



"*Flight*" photograph

WELLINGTON MARK III : A prototype Vickers Wellington long-range bomber fitted with two Bristol Hercules 14-cylinder two-row sleeve-valve radials of at least 1,400 h.p. each. Flying alongside is one of the later Supermarine Spitfires fitted with Rolls-Royce Merlin III engine driving a De Havilland three-bladed variable-pitch airscrew.

F.A.A. Handed Over to Admiralty

THE Admiralty assumed the administrative control of the Fleet Air Arm on May 24. As from that date the administration is being brought as far as possible into line with that of the rest of the Navy. The following is a broad outline of the arrangements which apply:—

Rear Admiral, Naval Air Stations.—A Flag Officer has been appointed as Rear Admiral, Naval Air Stations (short title, R.A.N.A.S.). His offices will be ashore at Lee-on-Solent and his flag will be flown there. He will administer the Naval Air Stations and direct and co-ordinate their work.

Personnel.—The Naval personnel in the Fleet Air Arm will be supplemented by R.A.F. Officers and airmen on loan until such time as full requirements can be met from naval sources. R.A.F. loan personnel will continue to serve in their R.A.F. ranks. The R.A.F. regulations concerning conditions of service, pay, etc., will continue to apply while this personnel is lent.

The dual commission system will no longer be necessary after May 24 and the R.A.F. commissions formerly held by R.N. officers have been terminated.

Training.—The Air Ministry will be responsible for the initial flying training of pilots, before they commence their specialised naval flying training. The Admiralty will be responsible for all other training of personnel for the Fleet Air Arm. This specialised naval training will be conducted as far as possible at the Naval Air Stations.

Air Stations.—The Admiralty took over the control of the following stations of the R.A.F. as from May 24, and the ship names of the four stations will be as follows:—

R.N. Air Stations	*Ship*
Lee-on-the-Solent	H.M.S. *Daedalus*
Ford	H.M.S. *Peregrine*
Worthy Down	H.M.S. *Kestrel*
Donibristle	H.M.S. *Merlin*

These Naval air stations will be administered as Fleet establishments and will be independent commands, commanded by either Captains, Captains (A), Commanders, or Commanders (A). Ratings' cap ribbons will bear the ship's name, but the stations will normally be referred to as "Royal Naval Air Station, Lee-on-the-Solent," etc.

In addition, Bermuda becomes a Naval Air Station administered by the Commander-in-Chief, America and West Indies Station, and will be known as H.M.S. *Malabar*.

Pending the issue of further regulations or special instructions which may be issued in any individual case, civil aircraft may be granted facilities at Naval Air Stations on the same conditions as prescribed for R.A.F. Stations.

Rear-Admiral, Naval Air Stations

REAR Admiral Richard Bell Davies, V.C., D.S.O., A.F.C., has been appointed Rear Admiral, Naval Air Stations, from May 24.

Rear Admiral Bell Davies was a gallant and distinguished officer of the Royal Naval Air Service. On November 19, 1915, Sqn. Cdr. Bell Davies (as he then was) in a single-seater Nieuport and Flt. Sub-Lt. Gilbert Formby Smylie in a Henry Farman carried out a bombing attack on Ferrijik junction on the Salonica-Constantinople railway. Flt. Sub-Lt. Smylie's machine came under heavy fire and he was forced to land. He released all his bombs except one (which failed to fall) at the station from a low altitude, and then landed in a marsh. He then saw that one bomb was still attached to the machine and set fire to the machine, knowing that the bomb would destroy it. He then began to walk towards Turkish territory, but at this moment he saw Sqn. Cdr. Bell Davies coming down to land near the burning aircraft. Fearing that he would be blown up by the bomb, Smylie went back and exploded the bomb with a pistol bullet. Bell Davies then landed at a safe distance away, and despite the approach of a party of the enemy, he took up Smylie in his single-seater and returned safely to his aerodrome—"a feat of airmanship," said the *London Gazette*, "that can seldom have been equalled for skill and gallantry." Flt. Sub-Lt. Smylie was awarded the Distinguished Service Cross.

The Distinguished Service Order had already been conferred on Sqn. Cdr. Bell Davies for bombing work in the Dunkirk area. He and Flt. Lt. Richard Edmund Charles Peirce made a number of bombing attacks together on the German submarine stations at Ostend and Zeebrugge, and on each occasion came under heavy and accurate fire, their machines being frequently hit. In particular on January 23, 1915, they attacked submarines along the Mole at Zeebrugge. At the outset Bell Davies was severely wounded by a bullet in the thigh, but in spite of the pain and loss of blood, he handled his machine with great skill for an hour. Both pilots flew down to close range, and each dropped eight bombs. For this exploit Bell Davies was made a D.S.O. At the close of the War he was awarded the Air Force Cross in recognition of his distinguished services. Though he was transferred to the R.A.F. on April 1, 1918, as a Lieutenant Colonel, he afterwards re-transferred to the Royal Navy, in which he has since served. His Royal Aero Club certificate is numbered 90.

Capt. L. D. Mackintosh, R.N., has been appointed Chief of Staff to the Rear Admiral Naval Air Stations. Capt. T. O. Bulteel, R.N., has been appointed to command H.M.S. *Daedalus*, Capt. (A) R. de H. Burton to command H.M.S. *Peregrine*, Capt. (A) H. J. Johnstone to command H.M.S. *Merlin*, and Cdr. R. St. A. Malleson, A.F.C., to command H.M.S. *Kestrel*.

Service Aviation

WELLINGTON MARK II. Two Rolls-Royce Merlin engines, the mark number of which may not at the moment be disclosed, are fitted in this new Wellington. It is armed with five machine guns and is believed to have a longer range than any bomber at present in service.

Record Recruiting

DURING the week ended May 20, 1,493 recruits joined the Royal Air Force, compared with 387 for the corresponding period last year. This a record entry. For the second week in succession and for four consecutive weeks the numbers entered have exceeded the thousand mark. The entries were made up of 117 pilots, observers, and cadets, 1,126 airmen, and 250 boys.

An "M. and S." Dagger

IT is now permissible to refer to the existence of a new type of Napier Dagger engine, known provisionally as the N.D.1SM. This unit has a two-speed supercharger, and, fitted in the Hereford bomber as now in production at the Belfast works of Short and Harland, it would confer a higher performance than does the Dagger VIII. The latter has a maximum output of 1,000 h.p. at 4,200 r.p.m. and 8,750ft., and is considered by the Air Ministry as having an "intermediate altitude" supercharger. Essentially, the N.D.1SM engine resembles the Mark VIII version.

The Newest Bristols

THE following engines are among the experimental units now under development by the Bristol Company: Aquila A.E. (3M), moderately supercharged; Aquila A.E. (3S), fully supercharged; Hercules III (H.E. (1sm)), two-speed supercharged; Hercules IV (H.E. (4M)), moderately supercharged and rated at 1,010/1,050 h.p. at 4,50ft.; Hercules H.E. (5M), medium supercharged; Pegasus P.E. (6S); Taurus II (T.E. (1M)), rated at 860/900 h.p. at 5,000ft. and fitted with a moderate-altitude supercharger; Taurus III (T.E. (1S)), with high-altitude supercharger; and Taurus T.E. (4S), also with a high-altitude supercharger.

Consolidated Boat for Felixstowe

AS already intimated, an American Consolidated Model 28-5 long-range military flying-boat has been acquired for experimental purposes and will shortly be delivered to Felixstowe. Aircraft of this type are standard equipment of the U.S. Navy and have taken over many of the duties of the Destroyer Force. Frequent routine transfers of PBY boats (the U.S. Navy designation) between bases 3,000 miles apart have become quite commonplace, and Capt. Archbold, who acquired the first commercial PBY, has flown his machine from San Diego to New York, a distance of some 2,700 miles overland. He took 17 hours for the trip. The same machine was flown over 19,000 miles in the Arctic by Sir Hubert Wilkins in search of the Russian pilot Levaneffsky.

An interesting sidelight on the development of the machine concerns take-off on a single engine, which has proved possible when carrying fuel for 1,300 miles. PBYs have also been landed and taken off in 5ft. waves.

A characteristic feature of the PBY is the float retraction. In their retracted position the floats form the wing tips and it is claimed that even when raised their buoyancy is sufficient to give adequate stability on the water should a landing inadvertently be made with them retracted. When lowered they serve as effective air brakes.

The fuel tanks, being integral with the wing structure, permit a large fuel capacity at only a fraction of the weight which would be required for separate tanks.

Four machine guns are mounted, one in the bow, one on each side of the decking just aft of the wing and one in a tunnel in the bottom of the hull just forward of the tail unit. Bombs or torpedo may be suspended from the wings outboard of the engines. The bomb racks are mounted within the wing and can be a permanent part thereof with no additional drag. The machine acquired by the Air Ministry is believed to have Pratt and Whitney Twin Wasp engines which should give a maximum speed not far short of 200 m.p.h.

New S.A.A.F. Station

THE new Waterkloof air station of the South African Air Force was recently inspected by the Hon. Oswald Pirow, Minister of Defence. The aerodrome is on the outskirts of Pretoria and is commanded by Major R. H. Preller, who gave a demonstration of aerobatics in one of the new Hurricanes. Mr. Pirow examined Hawker Hartebeests and Hurricanes and inspected the men's quarters.

The new aerodrome is already showing signs of becoming another Roberts Heights in military importance and is ideally situated on a large plateau off the Pretoria-Irene Road. It accommodates at present fifty machines and about 200 men and was started about two years ago, being hurriedly completed during the past six months. Additional quarters for some of the men, who are now accommodated in tents, are being built.

The Lysander II

FITTED with the Bristol Perseus XII sleeve-valve engine, the Westland Lysander Mark II army co-operation monoplane as now in service with R.A.F. squadrons has the following characteristics:—

Weight empty	4,160 lb.
Typical load (inc. 87 gals. fuel, 7 gals. oil, and crew)	1,855 lb.
Weight loaded	6,015 lb.
Speed at sea level	206 m.p.h.
Speed at 5,000 ft.	221 m.p.h.
Speed at 10,000 ft.	230 m.p.h.
Speed at 15,000 ft.	224 m.p.h.
Slowest flying speed (full load)	55 m.p.h.
Climb at sea level	1,600 ft./min.
Climb to 5,000 ft.	3.3 min.
Climb to 10,000 ft.	6.9 min.
Climb to 15,000 ft.	11.5 min.
Climb to 20,000 ft.	19.7 min.
Service ceiling	26,000 ft.
Take-off run for 50ft.	245 yards.
Landing run from 50ft.	330 yards.

Flying Accidents

THE Air Ministry regrets to announce the following accidents:—Able Seaman Leslie Goy, Royal Navy, lost his life in an accident which occurred on May 20 to an aircraft of H.M.S. *Glasgow*. P/O. Ronald Lunberg, who was not injured, was the pilot of the aircraft and Able Seaman Goy the only other occupant.

A/C.1 Alfred Dennis Jacobs died in the Military Hospital, Tidworth, on May 19, as the result of injuries received in the aircraft accident which occurred near Penton Newsey, Hampshire, on the same date.

Royal Air Force Gazette

Royal Air Force

Air Ministry, May 23

General Duties Branch

R. Marples (from Reserve) is granted a short-service commission as Pilot Officer on probation (May 8).

The following Pilot Officers on probation are confirmed in their appointments on the dates stated:—J. C. Mackintosh (April 19); Sir R. A. MacRobert, Bt. (May 7); W. Shearman, D. S. Smith (May 9); P. G. Crofts (May 11).

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers on the dates stated:—E. W. S. Scott (March 7); D. S. Scott (April 15).

Acting Pilot Officer on probation M. Paddle is graded as Pilot Officer on probation (May 7); Acting Pilot Officer on probation L. M. Whetham is graded as Pilot Officer on probation with effect from January 17 and confirmed in his appointment with effect from March 26.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—W. I. Collett, J. B. Voyce, E. G. Campbell-Voullaire (Acting Flight Lieutenant) (April 14); A. C. Brown (Acting Flight Lieutenant), A. J. F. Churchill (April 19); J. J. Raine (April 25).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—A. G. Griffin (January 29); D. C. Mauger, J. C. G. Macnab (March 31); M. H. Roth (April 18); J. L. Waters (Acting Flight Lieutenant) (April 23); J. F. Chandler (April 30); T. P. A. Bradley, W. R. Williams, R. J. Sage, B. H. M. Winslett, H. R. Hamilton, F. J. L. Duus, R. F. D. Anstead, T. W. T. McComb, D. A. Smith, G. T. Palmer (May 12); W. A. Pattison, J. A. C. White (May 16); W. B. Smith (May 17).

The following Flying Officers are granted the acting rank of Flight

Lieutenant on the dates stated:—W. G. Tailyour (Lieutenant, The Cameron Highlanders) (March 2); P. R. Beare (March 9); A. M. K. Phillips (March 15); J. H. Barrett (March 27); R. W. Gautrey (April 1); E. M. Ware (April 12); P. G. Jameson (April 16); A. E. Hyde-Parker, T. S. Rivett-Carnac (April 17); F. L. Newall (April 30); K. R. Rogers (May 8).

The following Pilot Officers are granted the acting rank of Flight Lieutenant on the dates stated:—J. L. Waters (March 7); R. E. Craven (April 17).

The following Flying Officers relinquish the acting rank of Flight Lieutenant on the dates stated:—A. J. Trumble (March 30); D. T. St. H. Dawes (April 19); G. D. Jones (April 27); J. Gillan (April 30); F. C. Phipps (May 5); C. A. Vernieux (May 8); K. E. Kennedy (May 13).

Lt. G. Starkey, R.N., is reattached to the Royal Air Force as a Flying Officer with effect from April 18, and with seniority of September 13, 1936; P/O. P. W. Ackroyd-Simpson takes rank and precedence as if his appointment bore date March 18. Reduction to take effect from April 14.

The following Flying Officers are transferred to the Reserve, Class C, on the dates stated:—R. E. Shorter (May 16); K. E. Kennedy (May 13).

Sqn. Ldr. M. F. Calder resigns his short-service commission (May 12); F/O. F. J. L. Donaldson relinquishes his short-service commission on account of ill-health (May 20).

Accountant Branch

The following Warrant Officers are granted commissions as Flying Officers on probation with seniority of March 27, and with effect from the dates stated:—V. H. Webb (May 8); A. R. B. King, F. S. Dean (May 9).

Medical Branch

F/O. J. D. Tonkinson, M.R.C.S., L.R.C.P., is promoted to the rank of Flight Lieutenant with effect from January 3, and with seniority of January 3, 1938. (Substituted for notification in *Gazette* of May 2.)

Errata

In the *Gazette* of January 31, for Ian Stewart Henderson read Ian Stuart Henderson; in the *Gazette* of April 18, for Charles James Montagu Montagu read Charles James Drogo Montagu; in the *Gazette* of May 2, for A. Nevers read A. Levers.

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

Lt. A. G. Tremain is granted a commission in Class C as Flying Officer with effect from April 20, 1938, and is transferred to Class CC with effect from May 7, 1938, and is granted the rank of Flight Lieutenant with effect from October 10, 1938; Capt. A. F. Muir is granted a commission as Flying Officer in Class C with effect from May 23 and with seniority of October 20, 1936; Sqn. Ldr. R. S. Gibson Craig Lucy, A.F.C. (R.A.F. Ret.), is granted a commission in Class CC as Flight Lieutenant (Honorary Squadron Leader) (February 16).

The following are granted commissions in Class CC as Flight Lieutenants on the dates stated:—Capt. J. M. Pye-Smith (February 6); Lt. E. M. Newman, R. A. R. Coote-Robinson (March 13); Maj. J. A. J. Farrell, D.S.O. (R.A.R.O.) (March 14); Capt. D. M. Greene (I.A. ret.) (March 25); Sec. Lt. J. S. Wilson (March 27); Lt. A. H. Read, M.M. (March 30)

Capt. A. H. Jones is granted a commission in Class CC as Flying Officer (Honorary Flight Lieutenant) (March 27); Lt. A. G. Forbes is granted a commission in Class CC as Flying Officer (March 26); Pilot Officer on probation M. H. Duckham is confirmed in his appointment (March 20).

The following are transferred from Class A to Class C on the dates stated:—*Flight Lieutenant.*—A. T. H. Willis (February 27). *Flying Officers.*—R. H. Rose (April 25); R. W. Barton (May 22).

F/O. G. W. Lavington is transferred from Class A to Class B (Equipment Branch) with his present rank and seniority (May 1); Sqn. Ldr. M. C. Pascoe relinquishes his commission on completion of service (April 15); Flt. Lt. P. C. Cabot relinquishes his commission on completion of service (February 1); F/O. J. F. Wells relinquishes his commission in Class C on completion of service (March 19); P/O. R. Marples relinquishes his commission on appointment to a short-service commission in the Royal Air Force (May 8).

Royal Air Force Volunteer Reserve

General Duties Branch

P/O. H. R. Bjelke-Petersen (R.A.A.F.R.) is granted a commission in that rank with effect from May 23 and with seniority of April 1, 1933.

The following reservists are granted commissions as Pilot Officers on probation (March 29):—Sgt. D. H. Macbeath, Sgt. J. G. Walker, Sgt. H. L. N. Davis, Sgt. R. C. Hockey, Sgt. W. R. L. Beaumont, Sgt. D. H. Nock, Sgt. T. C. Pick, Sgt. R. D. McLaren, Sgt. D. A. Cracknell, Sgt. M. E. Burnham, Sgt. R. A. R. Chalmers, Sgt. K. N. T. Lee, Sgt. C. H. Willis, Sgt. E. J. Martin, Sgt. J. G. Forbes, Sgt. R. A. McGowan, Sgt. R. A. Winter, Sgt. D. Wood, Sgt. G. M. Merrifield, Sgt. A. E. Hill, Sgt. S. P. Russell, Sgt. L. H. Wood, Sgt. P. R. McGregor, Sgt. A. F. Martindale, Sgt. E. T. Halley, Sgt. I. R. Batchelor, Sgt. R. Wilson, Sgt. D. E. Davies, Sgt. A. J. Claydon, Sgt. A. R. A. Forbes, Sgt. T. G. F. Ritchie, Sgt. R. Bowyer, Sgt. J. E. Jackson, Sgt. S. W. H. Howell, Sgt. N. S. Lacey, Sgt. G. Crawford, Sgt. C. T. Looke, Sgt. N. B. Berrington, Sgt. M. G. Olley, Sgt. D. G. Johnson.

Rear Admiral K. E. L. Creighton, M.V.O., is appointed Honorary Flight Lieutenant (March 30); Col. W. D. Hall, M.C. (I.A. Ret.) is appointed Honorary Flight Lieutenant (April 12); P/O. C. M. Wight-Boycott is promoted to the rank of Flying Officer (March 28).

The following Honorary Flight Lieutenants are granted the honorary rank of Wing Commander on the dates stated:—Sir Lionel A. D. Sturdee, Bt. (April 3); H. A. Joly de Lotbinière, M.C. (April 4); W. C. F. A. Wilson, O.B.E. (April 6).

P/O. J. S. Morton relinquishes his commission on appointment to a commission in the Auxiliary Air Force (May 23).

Administrative and Special Duties Branch

The following are granted commissions as Pilot Officers on probation with the honorary ranks stated (May 16):—*Group Captain.*—C. C. Brachi. *Squadron Leaders.*—R. W. Allen, J. D. Haddon, J. D. Piper, M.C., W. R. Thomson. *Flight Lieutenants.*—F. J. Balcombe, W. A. Skinner, G. Williams. *Flying Officers.*—J. J. R. Back, J. H. Boyer, E. W. Cole, R. H. Collins, I. R. Davies, K. Hassall, J. W. Piggott, W. A. Russell, T. W. Wiseman.

The following are granted commissions as Pilot Officers on probation (May 16):—E. F. D. Acland, A. E. Alderton, H. J. D. Arkell, E. J. Ashby, E. R. Barker, D.S.C., H. A. Bird, A. Blomfield, C. H. Brewer, M.C., C. C. Brill, J. C. Burney-Cumming, N. Bury, W. F. Carson, E. C. Crossley, E. C. Davies, M.C., A. T. Daw, K. M. Dawson, L. J. Empson, A. J. Garside, D.F.C., H. M. Goode, C. E. Gregory, R. D. Hambrook, G. Hamilton-Browne, G. R. E. Hayter, L. Henshall, M.B.E., H. D. Higham, F. T. Hull, T. P. Isaac, J. W. Jones, D. W. Lane, C. W. Langlands, C. M. Leman, M.C., D.F.C., L. I. Lowthian, A. C. Lyell, A. W. MacIlwaine, H. Maynard, C. R. Millbourn, R. Musgrave, C. Osenton, A.F.C., D. W. Patston, F. H. Rae, C. W. N. Raymond, F. L. H. Roberts, G. Rogerson, C. F. Roupell, C. E. Ruault, J. Scott-Taggart, M.C., E. M. C. Shipp, D. E. B. K. Shipwright, W. R. Tate, N. H. Thackrah, A. P. Thompson, O.B.E., D. Tidmarsh, M.C., G. F. Turberville, C. W. Usher, V. L. Watson, R. C. Williams, M.C.

Equipment Branch

The following Acting Pilot Officers are employed with the Royal Air Force with effect from the dates stated:—T. H. Snelling, H. C. Windsor (April 24); A. E. B. Rich (May 1); H. W. G. Triggs (May 8).

Medical Branch

The following are granted commissions in the ranks stated (May 23):—*Flight Lieutenants.*—J. C. Macgown, M.D., Ch.B.; H. Treissman, M.R.C.S., L.R.C.P., M.B., B.S., F.R.C.S. *Flying Officers.*—E. K. Brownrigg, M.R.C.S., L.R.C.P.; A. L. Knipe, M.B., Ch.B.; R. G. B. Wigoder, L.R.C.P. and S.

Auxiliary Air Force

General Duties Branch

No. 600 (CITY OF LONDON) SQUADRON.—J. N. L. Isaac is granted a commission as Acting Pilot Officer (January 12).

No. 601 (COUNTY OF LONDON) SQUADRON.—Flt. Lt. R. A. E. Luard relinquishes his commission (November 24, 1938).

No. 603 (CITY OF EDINBURGH) SQUADRON.—J. S. Morton is granted a commission as Acting Pilot Officer (May 23).

No. 605 (COUNTY OF WARWICK) SQUADRON.—R. C. Longsdon is granted a commission as Pilot Officer (April 15); Flt. Lt. J. V. Wood relinquishes his commission (March 7).

No. 611 (WEST LANCASHIRE) SQUADRON.—W. P. Barrell is granted a commission as Acting Pilot Officer (March 23).

No. 614 (COUNTY OF GLAMORGAN) SQUADRON.—The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—M. L. Edwards (February 16); N. S. Merrett (February 17); P. Farr (February 18).

No. 615 (COUNTY OF SURREY) SQUADRON.—A. S. C. Rose is granted a commission as Acting Pilot Officer (April 17).

No. 902 (COUNTY OF LONDON) SQUADRON.—H. M. Whitehead is granted a commission as Flying Officer (February 14).

No. 905 (COUNTY OF SURREY) SQUADRON.—Capt. V. A. Cazalet, M.C., M.P., is granted a commission as Flying Officer (April 21).

No. 920 (WEST LANCASHIRE) SQUADRON.—E. Errington, M.P., is granted a commission as Acting Pilot Officer (April 18).

No. 932 (HAMPSHIRE) SQUADRON.—V. E. Vincent is granted a commission as Flight Lieutenant (March 24).

No. 936 (COUNTY OF NORTHUMBERLAND) SQUADRON.—The following are granted commissions in the ranks stated (April 14):—F/O. R. E. Baty, M.C., P/O. G. H. Brown.

No. 937 (COUNTY OF NORTHUMBERLAND) SQUADRON.—R. L. Richmond is granted a commission as Flying Officer (April 15).

No. 945 (CITY OF GLASGOW) SQUADRON.—J. S. Houston is granted a commission as Flying Officer (April 20).

No. 946 (CITY OF GLASGOW) SQUADRON.—The following are granted commissions in the rank of Flying Officer on the dates stated:—R. N. Lochhead, M.C. (April 17); H. A. Underhill, M.C. (April 19).

Equipment Branch

Flt. Lt. E. J. Moorhead relinquishes his commission (May 21).

Auxiliary Air Force Reserve of Officers

General Duties Branch

J. V. Wood is granted a commission as Flight Lieutenant in Class C (March 7).

FROM the CLUBS and SCHOOLS

RENFREW.
THE total number of hours recorded by the C.A.G. section during the week ended May 19 was 77 hr. Mr. K. Templeton went solo. Last week 74 hr. were flown by members of the section.

NEWCASTLE-ON-TYNE.
Flying time for the week ended May 18 amounted to 111 hr., of which 22 hr. was put in by club members.

PORTSMOUTH.
The total flying time for the first 27 days of May amounted to 296 hr. Fifty members of the C.A.G. are now flying solo.

YAPTON.
During the first 27 days of May 205 hr. were recorded in the club's aircraft. There are now 71 members of the C.A.G. under instruction.

CINQUE PORTS.
During the week ended May 20, flying time amounted to 73 hr. Mr. Daniels, of the C.A.G. section, has made his first solo flight. In spite of high winds 117 hr. were flown the following week.

SCOTTISH.
A farewell party was held recently at the club in honour of Mr. R. D. Shepherd, who left the following day for service with the R.A.F. in the Near East.

NORWICH.
Sixty hours were flown by club and C.A.G. members last week. A civic reception will be given to No. 21 (B) Sqn. by the Lord Mayor of Norwich on June 15.

STRATHTAY.
Over 47 hr. were recorded during the week ended May 14. Mr. Neill put in his first solo flight. The first Civil Air Guard drill was held under the direction of Sergeant-major McCartney.

HANWORTH.
During the week ended May 19 over 109 hr. were recorded in the club's aircraft in spite of 3½ days of adverse weather conditions. Messrs. W. L. Foster, S. J. Harris, J. James and N. H. Linzee went solo

ISLE OF WIGHT.
Over 63 hr. were flown last week. The Misses N. Crinage, J. Broadsmith and Mr. E. Darby have gone solo. The Duke of Richmond and Gordon and Air Comdre. J. A. Chamier were among the visitors to the club.

SOUTH COAST.
Flying time during the week ended May 20 amounted to 81 hr. Messrs. H. A. Stringer, J. A. Kemp, and J. Trelawny have been appointed Sub-Unit Leaders of the club's C.A.G. section.
During last week 97 hr. were flown.

HORTON KIRBY.
In spite of five days of bad weather over 326 hr. were recorded during the month ended May 19. Messrs. D. H. Hall, E. G. Shrewsbury and A. N. Angus have gone solo. F/O. C. H. E. Coles has joined the staff as an instructor.

HERTS AND ESSEX.
The flying time for the fortnight ended May 26 amounted to 280 hr. Messrs. F. A. Puckridge, R. Richmond-Brown, C. T. A. Luke, A. E. Knight, J. J. Blake, E. S. Lane, S. E. Vinson, S. G. Fidoe, L. Oliver, I. Linder and F. J. Box have gone solo.

PLYMOUTH.
In spite of three days of high winds, 123 hr. were recorded during the week ended May 15. Messrs. H. V. Marshall, W. G. K. Gorrie and J. H. Tolman have gone solo.
During the following week 118 hr. flying was recorded.

REDHILL.
Flying time for the week ended May 20 amounted to 101 hr. A record was created for the aerodrome when 17 first soloists were sent off in one day.
During last week 186 hr. were recorded. Mr. S. G. Burden went solo.

MARSHALLS'.
The total flying time carried out during the week ended May 20 was 183 hr. Messrs. C. Knaggs and C. Flitton have carried out their first solo flight.
Last week's flying amounted to 221 hr. Additional first soloists were Messrs. Birbeck, Searight, Rawcliffe, Lee, Roles, Dalrymple, Campbell, Hirst and Franklin.

BROOKLANDS.
Messrs. R. Pepper, C. Nepean Bishop and D. Moss have passed their instructors' tests and their licences have been endorsed accordingly, the last two having passed as assistant instructors. Messrs. S. B. Duncan, H. Wadley, W. Gracey and Mrs. N. Tucker have gone solo. Viscount Gort visited Brooklands on Saturday, May 20, and inspected the A.D.C.C. squadron's headquarters. Fifty members of the squadron paid a visit to Halton camp.

LINCOLNSHIRE.
During the week ended May 20 rain and high winds interfered with flying, but in spite of this 60 hr. were recorded. Miss Brompton, Messrs. L. Outhouse, S. Harrison, A. W. Bennyworth, I. Parke, M. H. Genney and H. Crook went solo.
Last week 143 hr. were logged.

BEDFORD.
Mr. G. L. A. Dudeney and Mr. R. H. Kemp won the landing competition and the bombing competition, respectively, held during the afternoon of Empire Air Day. Miss A. Spearman, Miss L. Duncombe, Messrs. J. Wilmott, E. F. Duncombe, H. A. Hill, K. Wombwell, H. S. Jackson and A. H. May have gone solo.

WEST SUFFOLK.
The club's Taylorcraft machines were on exhibition at Mildenhall Aerodrome on Empire Air Day. During the week ended May 21, 40 hr. flying were recorded.
Last week 40 hr. were flown. Three new members, Capt. F. Bright, Messrs. G. Huett and E. S. Capstick have joined the club.

IPSWICH.
Three days of high winds reduced the flying time for the week ended May 15 to 48½ hr.
During the ensuing week 54½ hr. were recorded. Messrs. S. A. Vinyard and H. F. Rampley went solo. Mr. R. Hawkins has been appointed chief instructor of the C.A.G. unit, the committee of which will organise a treasure hunt on June 9.

BRISTOL AND WESSEX.
More than 140 hr. were recorded during the fortnight ended May 18. During this period Mr. T. R. Young went solo. Mr. D. A. Taylor has joined the staff of the club as an instructor. The club's first Moth Minor is expected in the middle of June.
Last week's flying time amounted to 102 hr. Messrs. L. S. Daniels, R. J. Hinton and D. W. Ellis have gone solo.

ROMFORD.
Over 226 hr. were logged by the club's aircraft during the fortnight ended May 21. That week-end officers and cadets of the No. 85 Sqn. (Southgate) A.D.C.C. were shown round the aerodrome at Maylands. Messrs. Over, Gill, Winter and Carroll have gone solo. The club has taken over the lease of the Crossways Club, the site of which will be used for an aeronautical school and aerodrome.

WESTON.
Sixty-six hours were recorded during the week ended May 15. Messrs. R. Bridgman, R. A. Rioch, J. Francis, J. Landsdale, H. F. Harris, S. A. Rees, W. D. Payne and R. E. Hutchin and Miss Dowling went solo.
The following week 45 hr. were recorded. Members of the C.A.G. section co-operated with the Yatton A.R.P. authorities on May 21.

THANET.
Over 117 hr. were flown during the week ended May 15. Twenty-two C.A.G. members took part in the Kent National Service Parade at Broadstairs recently. Mr. W. Lingford spoke at Ramsgate on C.A.G. matters.
During the following week 143 hr. flying was recorded in 2½ days—a record for Straight-operated clubs. Mr. N. L. Storey has gone solo.

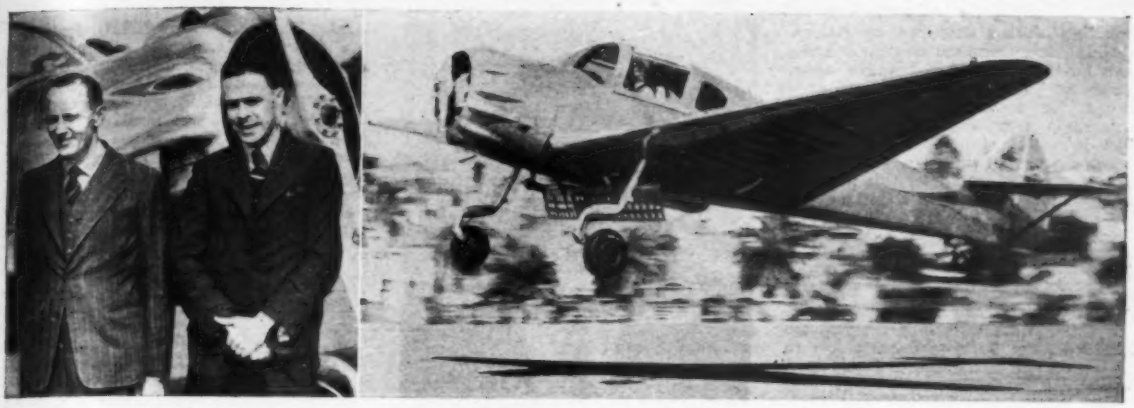
DONCASTER.
Strong winds and rain interfered with instruction on three days of the fortnight ended May 20, during which period 102 hr. were recorded. Messrs. K. Cartlidge, J. Pott, Peck, England, Forth, Seagrave and Miss M. J. Long went solo. A C.A.G. dance will be held on June 8.
Last week 90 hr. were logged by club aircraft. During that period Mr. P. Bannister went solo.

LONDON.
Over 89 hr. were recorded in the club's aircraft during the week ended May 19. Mr. E. Goss has made his first solo flight. Messrs. J. M. I. McIntyre, W. Stern and G. E. W. Hitchcock have joined the club as new members.
Last week 253 hr. were flown in club aircraft. Messrs. E. Blackall, H. Peters, D. Fraser Turner, W. A. Tamblin, J. J. F. Griffith, G. E. Main and Mrs. A. Carnegie have gone solo.

EXETER.
A demonstration of clay pigeon shooting was given recently by Messrs. P. Stanbury, F. Shephered and J. McCririck. A party of ten members visited Mount Batten and took a flight in an Empire flying boat. Over 124 hr. were recorded during the week ended May 15.
The following week 108½ hr. were flown. Messrs. B. A. Q. Wynyard Wright, C. R. Greenslade, Miss D. C. Wheatley and Mrs. T. K. Breakell went solo.

O.U.A.S. Dinner

THE twelfth annual dinner of the Oxford University Air Squadron was held last Friday. Owing to the pressure on space, caused by the Whitsun holidays, it is impossible to publish an account of this pleasant function this week. We hope to do so in our next issue



CHELTENHAM SMILES IN CALIFORNIA : On left, Mr. George Dowty enjoys a joke with Mr. Stanley H. Evans at the Ryan School of Aeronautics, where the latter, who was associated with leading British aircraft firms before going to America, is the director of engineering. Mr. Dowty has just completed an extensive tour of the States in connection with his various undercarriage systems, one of which can be seen fitted to the 1939 Ryan S-C metal monoplane on the right.

THE INDUSTRY

LAST week a new company having an unusual purpose was formed, with Mr. C. W. A. Scott (of Australia Race fame) in the office of governing director. Its title is Aircraft Collection and Delivery, Ltd., and its offices are at Grand Buildings, Trafalgar Square, London, W.C.2.

While it is hardly necessary to explain the objects of the new concern, for they are disclosed by its title, it is interesting to note that its active operations have already started. At the moment it is engaged in flying a large number of Avro Ansons to the Greek Government.

Mr. Scott and his co-director, Mr. John Leggitt, have retained the services of a number of well-known and reliable pilots. The new company is able to handle aircraft collection and delivery to and from any part of the world.

Obituary

FLIGHT regrets to record the death of Mr. Horace Brearley, which took place suddenly on Thursday, May 18. Mr. Brearley was one of the directors of J. J. Habershon and Sons, Ltd., the well-known strip and sheet steel manufacturers of Holmes Mills, Rotherham.

Airscrews on Show

AMONG the exhibits at the R.Ae.S. Garden Party "static" show was an interesting display by the Airscrew Co., Ltd., of Weybridge—inadvertently omitted from our notes last week.

They showed a wooden airscrew blade as now being produced for the Air Ministry, in a wide range of sizes, a number being of the compressed-wood type for use with Rotol constant-speed hubs. Step-by-step details of the manufacture of these blades were also illustrated by actual examples.

Another Use for Bismuth

RESIN, tar, sand, and lead are often used to support the inside walls of a tube during bending operations. Undoubtedly, these materials prevent any tendency on the part of the tube to buckle, flatten, or rupture, but usually they possess one inherent disadvantage —that it is practically impossible to ensure that all particles of the filler have been removed in the ensuing cleaning process.

In certain instances the use of lead as a filler is unsatisfactory, for the reason that its comparatively high melting point has deleterious effects on the physical properties of the tube to be bent. Sand, on the other hand, is difficult to pack solidly enough to prevent buckling, especially in tubes of small diameter.

With the object of overcoming these difficulties, Mining and Chemical Products, Ltd., of Shell-Mex House, Victoria Embankment, London, W.C.2, introduced the alloy "Cerrobend." This material is an alloy of tin, lead, cadmium, and bismuth. It has a melting point of only 160 degrees F., and its use makes it possible to deal with tubes having a wall thickness of as little as 0.005in. for bending to small radii. Owing to its setting expansion this metal filler conforms so closely to the inside of the tube that the latter can be bent as if it were a solid rod. If cooled suddenly "Cerrobend" solidifies with a fine-grain structure, and in this condition has an elongation factor of 140-200 per cent. If the tubes are oiled before loading, there is no possibility of the alloy coming into contact with the walls, since the chance of the oil film being broken at the operating temperature of 100 degrees C. is remote. Incidentally, "Cerrobend" can be cast round extruded sections to prevent

ENTENTE CORDIALE : The party of French Air Force Officers that recently visited this country photographed while inspecting the Supermarine assembly and erecting shops of Vickers-Armstrong's at Southampton. General Dufieux is seen shaking hands with F/O J. K. Quill. On the right are Flt. Lt. G. Pickering and Mr. Alex. Dunbar (chief of the aviation side of the Vickers organisation).

spreading during bending operations.

Mining and Chemical Products, Ltd., have developed another bismuth alloy, known as "Cerromatrix," for use as a matrix for mounting complex-shaped punches in press tools to eliminate the need of machining non-working surfaces to fine limits. In the past, various substances have been used for this purpose, but usually they have had serious disadvantages, such as comparatively high melting points, with the subsequent risk of "drawing" the temper of tools, and setting shrinkages, causing looseness and finally insufficient mechanical strength.

"Cerromatrix," it is claimed, eliminates these faults. Its flow temperature of 248 degrees F. is sufficiently low to obviate all risk of damage to highly tempered tools, while its tensile strength of 13,000 lb./sq. in. and a Brinell hardness of 19.0 make tools so built as durable as those assembled by any other method, while the cost of production shows marked economy over orthodox methods.

"Cerromatrix" is also suitable for use in connection with the assembly of jigs for wing spars, fuselage frames, etc. The usual practice is, of course, to use jigs of bolted construction with holes accurately located by jig-borers. The new development is to build the main frame of the jig by arc welding and then to locate the essential jig parts on a master model and mount them in the main frame by flowing "Cerromatrix" into suitably cut anchorages. By this means it is possible to construct a large number of complete jigs from one master model in a fraction of the time and cost of the old method.

"Flight" photograph

INTERESTED SPECTATORS at the recent R.Ae.S. Garden Party: Mr. J. D. Titler, managing director of the Airscrew Co., Ltd., and Miss Pringle.

Bearings that Spread

GENERALLY speaking, there are two types of plain metal bearings suitable for use in internal-combustion engines. On the one hand there is the white-metal group and on the other the lead-bronze type. In certain circumstances, and unless made of special metal, such bearings may have serious disadvantages should they run hot through incorrect fitting or usage. In the case of the former, the metal is liable to run, while with the latter there is the chance of seizure with consequent damage to the crankshaft.

With the object of minimising the risk of damage through overheated plain bearings, Wellworthy Piston Rings, Ltd., have evolved a new type of bearing metal which, when subjected to extreme heat, spreads without any signs of disintegration. To demonstrate its efficiency a test was recently conducted in which a pair of bearings were fitted up with a considerably reduced clearance. This resulted in a marked loss of power, but after a short length of time, it is stated, the loss gradually remedied itself and at the end of 20 hours the engine was running normally.

When the bearings were examined it was found that one half showed signs of marked seizure, but at the same time the surfaces were comparatively smooth and free from ridges.

What was more interesting was the fact that under the excessive heat a general spread of material had taken place, thereby producing the clearance required for the bearing to function efficiently. Towards each end of the half-bearing the measurement was 0.04in. greater than towards the centre.

The metal used for the bearing is prepared from R.R.A.C.9. Full details are obtainable from Wellworthy Piston Rings, Ltd., Lymington, Hants.

BROUGH PERSONALITY: Last week we published a number of portraits of members of Blackburn Aircraft, Ltd. Here is another, well known to many Service and other users of the firm's products: Mr. G. C. F. Ely, publicity and liaison officer. He flies the company's Stinson, and has recently been passed out on Skuas.

British Plugs for U.S. Machines

OPERATORS of American-engined aircraft will be interested to learn of the successful development of a British sparking plug for American engines. The plug has successfully completed its Air Ministry laboratory and flight tests, while Pratt and Whitney Aircraft and the Lycoming Division of the Aviation Manufacturing Corporation have, as a result of specific tests carried out by them, granted their approval. Other American aircraft engine manufacturers are conducting tests at this moment.

The plug has been developed by K.L.G. Sparking Plugs, Ltd., of Putney Vale, London, S.W.15. It is known as the K.L.G. RA-954, while its unscreened counterpart is known as the 954-RL. Both plugs follow modern K.L.G. practice. They have a central electrode stem encased in a copper tube or sheath drawn in close contact with the stem and terminating in a large area head. That well-known K.L.G. feature, the multi-earth electrodes of fine platinum-iridium wire, is, of course, fitted.

The standard type RA-954 plug is integrally screened by a tubular extension of the gland nut insulated with a mica lining. This screen and its threaded extremity are finished to the requisite American dimensions to provide the necessary connection with the high-tension leads of the ignition harness.

In the case of the unscreened version, the 954-RL, a standard "Long Rajah" type of terminal is used to accommodate the high-tension lead when the system is not screened.

Airline operation by British Airways, Ltd., has, it is stated, shown that periods of more than 100 hours can be completed without removal from the engines and without impairing the efficiency or reliability of the plug.

Expansion

PLANS submitted by Head, Wrightson Stampings, Ltd., for their new factory at Seaton, near West Hartlepool, were passed at a recent meeting of the Stockton Rural Council. The company, which has its registered offices at Thornaby-on-Tees, will specialise in aircraft and automobile components. It is expected to start production in August.

In Brief

Increased production caused by a steady demand for "Luxor" goggles has enabled E. B. Meyrowitz, Ltd., of 157, Regent Street, London, W.1, to reduce the price of their No. 6 model, fitted with synthetic unbreakable lenses, to 35s. In the near future this company will be producing a new featherweight model giving an extra wide range of vision.

* * *

A few months ago a subsidiary company of Jablo (Holdings), Ltd., known as Moulded Components (Jablo), Ltd., was formed. Since then it has been decided to increase the capital of the subsidiary company to £20,000. Lord Selsdon has joined the board as chairman and Mr. Hamilton Fulton, O.B.E., has been appointed managing director, while Mr. B. Jablonsky will be the general and technical manager.

The purpose of this expansion is to enable the company to produce die-moulded improved wood components made under Mr. Jablonsky's patents.

Left to right, the 954-RL, RA-954 and RV-16/5 K.L.G. plugs. The first two are for American engines and the last-named for Bristol sleeve-valve units.

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ELASTIC STIFFNESSES OF A SKIN-COVERED FRAMEWORK

The Effects Upon the Flexural and Torsional Stiffnesses of a Wooden Box-wing Test Specimen Due to Different Dispositions of the Grain of Thin Ply-covering

By E. W. H. THOMPSON, A.F.R.Ae.S.

IT is now generally observed that the attainment of higher speeds of flight has brought with it the problem of designing aircraft structures primarily to meet the requirements of rigidity; that for a certain speed of flight, if sufficient rigidity in flexure and torsion is obtained in a structure such as a monoplane wing, the strength of the wing, based on the present specified load factors, is also ensured. Whether the problem of the rigidity of an aircraft component can be made subordinate to the strength problem and be solved simultaneously during the customary stress analysis by suitably modifying the load factors for the affected part is open to question.

In a monoplane wing with spars it has been usual to obtain torsional stiffness by means of a skin covering between the spars; a box wing is thus formed capable of resisting torque by differential bending and twisting of the spars and by shear stresses in the skin. Flexural stiffness in this arrangement is mainly supplied by the spars, although the skin contributes a not negligible portion.

Any addition to the torsional stiffness of a given wing is most economically made when the available material is disposed in the skin covering. Such a disposition of material is also most effective in securing flexural stiffness. There arises then the tendency to design a wing as a shell that can resist both bending and torsion.

Up to the stage when the design of a wooden wing was determined solely by load factors, that is, before the flutter problem became of major importance, conservative values for the elastic constants of aircraft timber were adopted as affording a safe basis for design. Although the use of safe values for the elastic constants of timber is still desirable in strength estimates, the use of *actual* values is imperative in any consideration of the elastic stiffness of a wing for avoiding flutter; here it is of importance to know the *actual* deformations under load. Since, however, timber is a variable material the assignment of any particular value as an *actual* value to an elastic constant must become eventually a matter of probability of a frequency distribution. In practice, of course, selection of timber and control tests are usual.

The following experiments were carried out in order

Firstly, to observe generally the behaviour of panels of thin skin under flexure and torsion;

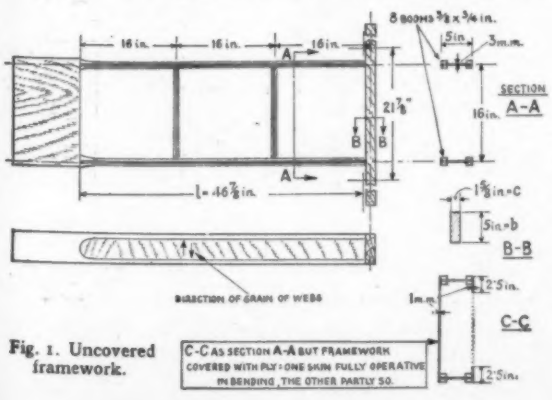

Fig. 1. Uncovered framework.

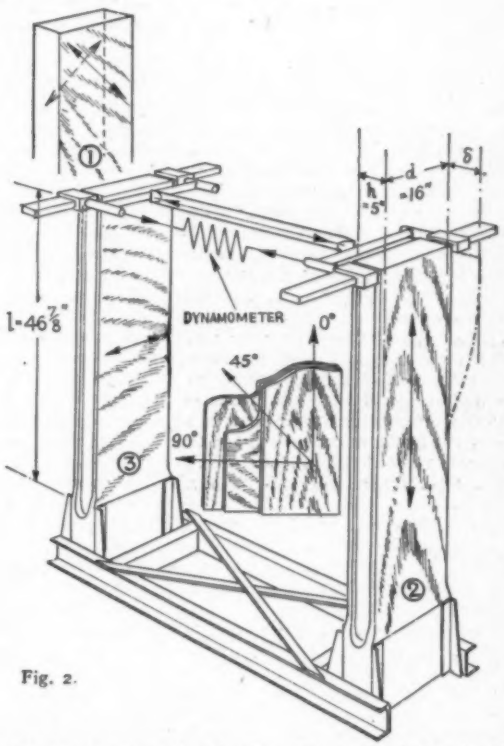

Fig. 2.

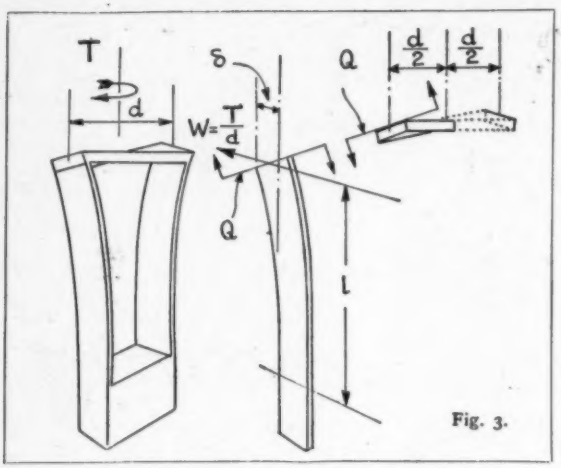

Fig. 3.

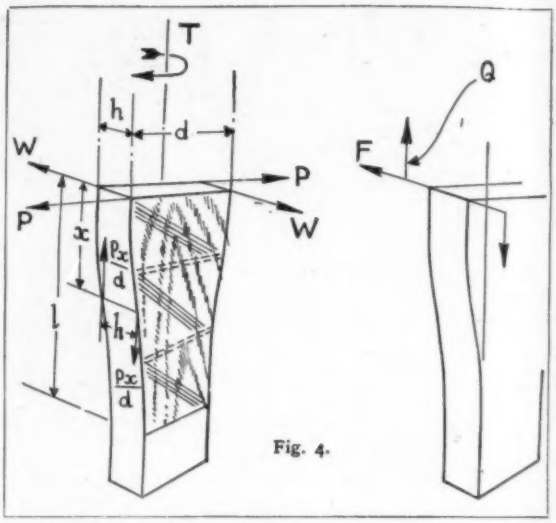

Fig. 4.

Secondly, to compare qualitatively the contributions made to the stiffness in flexure and in torsion of a standard wooden framework, by thin ply covering whose grain is disposed in different directions, and

Thirdly, arbitrarily to assign more probable *actual* values to the elastic constants of spruce and plywood, and by analysis of the loads on a thin skinned framework to compare calculated deflections with deflections obtained by experiment.

Test Specimens and Their Behaviour

Three similar frameworks to the dimensions shown in Fig. 1 were made of spruce and birch-bakelite three-ply. The spruce and plywood for each frame came from the same batches and were assembled by one workman so as to ensure similarity of material and workmanship. Each framework resembled a short two spar wing with a stiff end rib, light intermediate ribs, but without covering. It is to be noted that the grain directions of the outer plies of the three-ply webs of the spars were at right angles to the length of the specimen, and that the spars were not torsionally rigid.

Two of the frameworks were assembled in the test-rig shown in Fig 2, and pure torque applied to each framework by means of the dynamometer and rigid centre bar. The deflections of the side beams in the direction of pull of the dynamometer were measured at the point of application of the loads, and a note made that the end rib or cross beam was twisted throughout its length as shown in Fig. 3.

The rigid centre bar was then removed, the dynamometer attached in its stead, and the frameworks loaded as simple cantilevers. The deflections in the direction of pull of the dynamometer were measured as before.

The open faces of each framework were then covered with 1M/M birch-bakelite ply as shown in Fig. 2. The specimens were numbered 1, 2, and 3 and differed from each other only in the disposition of the long grain of the ply covering sheets. The long grain direction of a three-ply sheet is defined as the direction of the long grain of the outer plies. Young's Modulus E and the Modulus of Rigidity G of a ply sheet in the direction of long grain are given the symbols E_0 and G_0 respectively. Similarly in the directions 45° and 90° to the long grain the symbols are E_{45}, G_{45}, E_{90}, and G_{90}. These directions are shown clearly in Fig. 2, where Specimen 1 has long grain at 45° to its length, Specimen 2 at 0° to its length and Specimen 3 at 90° to its length. Furthermore, in Specimen 1, the 45° grain of one face may be supposed to be the spiral continuation of the grain of the other face.

Two of the covered frameworks were mounted in the test rig and loaded as cantilevers. Deflections of the free ends were measured and the observation made that the ply on the compression sides of the faces waved while the tension sides could be drummed with the finger.

When pure torque was applied to the specimens, the end ribs or cross beams did not twist since they were constrained by the ply coverings. These latter, however, developed diagonal tension fields with well marked waves as diagonal ties from the nodal points of the framework. This is indicated in Fig. 4. The side beams deflected as cantilevers with constraining moments at the free ends. One of the covered specimens was removed and replaced by the untested specimen. The loadings were repeated and the final readings of deflections taken.

Deflection-load graphs were plotted from the test readings and straight line laws obtained.

In Tables 1 and 2 are tabulated the magnitudes of deflections for given loads and torques.

By direct ratio deflections have been calculated for loads of 100 lb. and torques of 2,000 lb. ins. These are given in Tables 3 and 4.

The stiffnesses in flexure and torsion of the specimens are shown comparatively in Figs. 5 and 6, which are graphs of Tables 3 and 4.

TABLE 1.
TEST READINGS OF FLEXURE.
Straight Line Portion of Graph.

Specimen.	Deflection in Inches at l = 46⅛in.	Load in lbs. at l = 46⅛in.
Uncovered Frame...	.50	200
(1) ...	78	350
(2) ...	.71 64	400 360
(3) ...	.82	400

TABLE 2.
TEST READINGS OF TORSION.
Straight Line Portion of Graph.

Specimen.	Deflection in Inches at l = 46⅛in. on an Arm of 12.97in.	Load in lbs. at l = 46⅛in. on an Arm of 10.94in.
Uncovered Frame...	.60	160
(1) ...	.23	360
(2) ...	272	240
(3) ...	.270	230

TABLE 3.
TEST READINGS OF FLEXURE.

Specimen.	Deflection in Inches at = 46⅛in.	Load in lbs. at l = 46⅛in.
Uncovered Frame...	.250	100
(1) ...	.223	100
(2) ...	177	100
(3) ...	205	100

TABLE 4.
TEST READINGS OF TORSION.

Specimen.	Deflection in Inches of Side Beam at l = 46⅛in.	Torque in lb. in. at l = 46⅛in.
Uncovered Frame...	.422	2,000
(1) ...	.672	2,000
(2) ...	.128	2,000
(3) ...	.132	2,000

Analyses of Stiffnesses

The discussion of the stiffnesses of the box-wing test specimens will be arranged under two heads :—

(*a*) Flexural Stiffness and

(*b*) Torsional Stiffness.

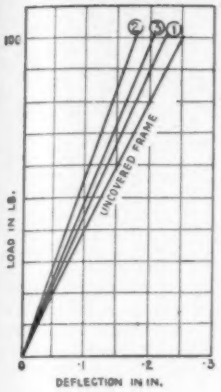

Fig. 5.
Flexural Stiffness.

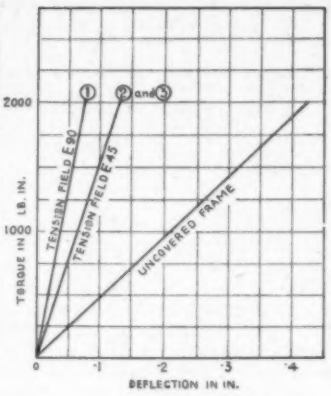

Fig. 6.
Torsional Stiffness.

Flexural Stiffness: It is proposed to assign arbitrary but more probable *actual* values to the elastic constants of birch-bakelite three-ply and spruce. These are given in Table 5.

TABLE 5. ELASTIC CONSTANTS.

Material	Young's Modulus / 10^6 lb./in.^{2}			Modulus of Rigidity / 10^6 lb./in.^{2}		
	E_0	E_{45}	E_{90}	G_0	G_{45}	G_{90}
Birch-Bakelite Three-ply...	1.75	.5	.96	.135	.658	.135
Spruce ...	1.75	—	—	—	—	135

The deflection of a composite beam of two materials may be calculated by engineers' bending theory if the area of the material of lesser E is reduced in the ratio of the two Es. That is, if an equivalent section in one material is formed. The application of this artifice may be extended to meet the case of a composite beam of more than two materials.

In the uncovered framework the E of the spruce flanges is 1.75×10^6 lb./in.^{2} and the longitudinal E of the ply webs is $E_{90} = .96 \times 10^6$ lb./in.^{2} $\therefore \frac{E_{90}}{E} = .55$

Referring to the section A A in Fig. 1.
Equivalent area of web of side beam is

$$A = \frac{3}{25.4} \times 5 \times .55 = .325 \text{ ins.}^2$$

I of flanges of one side beam
$= 5.127$ ins.^{4}
I of web of one side beam

$$= \frac{3}{25.4} \times .55 \times \frac{5^3}{12} = .675 \text{ ins.}^4$$

Total I of one side beam is I $= 5.8$ ins.^{4}

In the covered frameworks it is assumed that 5 inches of the compression side as well as all the tension side of the coverings are effective in bending. This is indicated on section C C in Fig. 1. The neutral axes of the equivalent sections are found and thence the I s.

In Table 6 are given the flexural constants of the sections.

TABLE 6. FLEXURAL CONSTANTS OF SECTIONS.

Specimen.	E/10^6 lb./in.^{2} for Spruce.	G/10^6 lb./in.^{2} for Spruce.	E/10^6 lb./in.^{2} for Ply Covering.	Equivalent I in Spruce of Section in.^{4}	Equivalent A in Spruce of Webs in.^{2}
Uncovered Frame..	1.75	.135	—	11.60	.65
(1) ..	1.75	.135	.5	13.11	.65
(2) ..	1.75	.135	1.75	16.65	.65
(3) ...	1.75	.135	.96	14.46	.65

The deflection of a cantilever with concentrated end load is given by

$$\delta = \frac{Wl^3}{3EI} + \frac{6}{5}\frac{Wl}{GA} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (1)$$

In this expression is included the shear deflection of the webs, the shear deflection of the flanges is negligible.

$l = 46\frac{1}{8}$ ins.

$$\therefore \delta = \frac{W}{I}\left[\frac{19600}{10^6}\right] + W\left[\frac{640}{10^6}\right]$$

Substituting the I s from the above table and making W equal to 100 lb., the following deflections are obtained and compared with the test deflections of Table 3.
This is done in Table 7.

TABLE 7. CALCULATED FLEXURAL STIFFNESS AS A PERCENTAGE OF MEASURED STIFFNESS.

Specimen.	Measured Deflection of Specimen for Load of 100 lb.	Calculated Deflection of Specimen for Load of 100 lb.	Percentage Ratio of Stiffness. Calculated / Measured.
Uncovered Frame ...	.233	.250	107%
(1) ...	.214	.223	104%
(2) ...	.182	.177	97%
(3) ...	.201	.205	103%

Torsional Stiffness (Uncovered Framework): The loads on the side beams and on the end rib or cross beam are as shown in Fig. 3. The torques Q constitute a balanced system of internal forces.

Strain Energy of Side Beam.

$$U_1 = \int_0^l \frac{M^2}{2EI}\,dx + \frac{3}{5}\frac{W^2 l}{GA}$$

The second term of the expression is the shear strain energy of the web, the shear strain energy of the flanges is negligible.

$$U_1 = \int_0^l \frac{[W(l-x) - Q]^2}{2EI}\,dx + \frac{3}{5}\frac{W^2 l}{GA}$$

$$U_1 = \frac{1}{2EI}\left[\frac{W^2 l^3}{3} + Q^2 l - WQl^2\right] + \frac{3}{5}\frac{W^2 l}{GA} \quad .. \quad (2)$$

Strain Energy of Half Cross Beam

$$U_2 = \frac{1}{2}Q\theta = \frac{1}{2}Q.\frac{Q\frac{d}{2}}{GK} = \frac{Q^2 d}{4GK}$$

where K is the torsional constant of the cross beam.

$$K = .263bc^3 \text{ where } \frac{b}{c} = 3$$

In this case $b = 5$ ins. $c = 1\frac{1}{8}$ ins.

$$U = U_1 + U_2$$

$$\frac{\partial U}{\partial Q} = \frac{\partial U_1}{\partial Q} + \frac{\partial U_2}{\partial Q} = 0$$

that is $\left[\frac{(2Ql - Wl^2)}{2EI}\right] + \frac{Qd}{2GK} = 0$ .. .. .. (3)

Length of Beam l $= 46\frac{1}{8}$ ins.
E of Spruce $= 1.75 \times 10^6$ lb./in.^{2}
G of Spruce $= .135 \times 10^6$ lb./in.^{2}
I of Side Beam $= 5.8$ ins.^{4}
A of Web $= .325$ ins.^{2}
K of Cross Beam $= 5.65$ ins.^{4}
Length of Cross Beam d $= 16$ ins.
substituting the above in equation (3)

$$Q = 7.16\,W \quad .. \quad .. \quad .. \quad .. \quad .. \quad (4)$$

Deflection of Side Beam.

$$\delta = \frac{\partial U}{\partial W} = \frac{1}{2EI}\left[\frac{2W^3}{3} - Q^2 l\right] + \frac{6}{5}\frac{Wl}{GA} \quad .. \quad .. \quad (5)$$

substituting (4) in (5) together with the other values.

$$\delta = \frac{3885W}{10^6}$$

when $W = \frac{T}{d} = \frac{2000}{16} = 125$, $\delta = .486$ ins.
this compares with $\delta = .422$ ins. from test.

giving a percentage ratio $\frac{\text{calculated stiffness}}{\text{measured stiffness}}$ of 87 per cent.

Torsional Stiffness (Covered Framework): When torque is applied to the framework the ply sheets develop diagonal tension fields as indicated in Fig. 4. The strain energy of one side beam and one sheet will be considered.

The side beam bends as a cantilever under load F and constraining moment Q supplied by the skin covering. This constraint prevents the twisting of the end rib. The cantilever deflects, but the direction of the plane of the end rib does not change. The bending moment on the beam is represented by the equation

$$EI\frac{d^2y}{dx^2} = F(l-x) - Q \quad .. \quad .. \quad .. \quad .. \quad (6)$$

in which the end conditions of the beam are

$$\frac{dy}{dx} = 0 \text{ when } x = 0 \text{ and } x = l.$$

On integrating (6) and inserting the end conditions it is found that $Q = \frac{Fl}{2}$

Strain Energy of Side Beam.

$$U_1 = \frac{1}{2EI}\left[\frac{F^2l^3}{3} + Q^2l - FQl^2\right] + \frac{3}{5}\frac{F^2l}{GA} \quad .. \quad (2a)$$

substituting $Q = \frac{Fl}{2}$

$$U_1 = \frac{F^2l^3}{24EI} + \frac{3}{5}\frac{F^2l}{GA}$$

Strain Energy of Sheet. The deflection of a diagonal tension field sheet with rigid boundary girders is $\frac{4}{E_1}\frac{Pl}{dt}$

where P is the shear load,
l is the length of the sheet,
d is the width of the sheet,
t is the thickness of the sheet, and
E_1 is the elastic constant of the field along the tension diagonals.

∴ Strain Energy of Sheet

$$U_2 = \frac{P}{2}\cdot\frac{4}{\lambda E_1}\cdot\frac{Pl}{dt} = \frac{2P^2l}{\lambda E_1 dt}$$

where λ is a constant representing the effect of non-uniformity of the tension fields due to the non-rigidity of the boundary girders. It is unfortunate that the introduction of this constant λ is necessary, since it will be observed that a standard framework of non-rigid boundary girders will deflect different amounts under the influence of tension diagonal fields of different E s. By the above approximate analysis a different λ is required for each tension field. The problem is stated completely by means of differential equations in the paper on "Plane Panel Frames of Very Thin Sheet" by H. Wagner. These equations have been solved by approximate methods. Wagner's analysis shows that with non-rigid boundary girders only part of the panel is stressed and acts as diagonal ties. The use of λE_1 is an attempt to represent this.

∴ Total Strain Energy of one side beam and one sheet is

$$U = U_1 + U_2$$

$$U = \frac{F^2l^3}{24EI} + \frac{3}{5}\frac{F^2l}{GA} + \frac{2P^2l}{\lambda E_1 dt}$$

The external torque acting on the box wing test specimen is $T = Wd + Ph$

where W is the load on the side beam and P the load on the panels

that is $P = \frac{T - Wd}{h} \quad .. \quad .. \quad .. \quad .. \quad (7)$

so that $\frac{dP}{dW} = -\frac{d}{h} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (8)$

The tension field exerts end loads on the boundary girders so that at distance x from the stiff rib, the end load on one boundary girder is $\frac{Px}{d}$ as shown in Fig. 4. The boundary girder adjacent also has an end load $\frac{Px}{d}$ in the opposite direction, from the other sheet. Therefore at distance x, the side beam comprising these adjacent boundary girders has a moment on it of $\frac{Ph}{d}x$. That is, the side beam may be supposed to have a load at its end of $\frac{Ph}{d}$ opposite in direction to W. This is represented by

$$F = \left(W - \frac{Ph}{d}\right) \quad .. \quad .. \quad .. \quad .. \quad (9)$$

so that $F = \left(2W - \frac{T}{d}\right)$

and $\frac{dF}{dW} = 2 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (10)$

It is to be noted that the side beams have additional end loads downwards of P, since they act as supports to the cross beam which is loaded with components from the tension field. The strain energy in the side beams due to these loads P will be neglected in this discussion.

The analysis of the Strain Energy of a Cantilever with load F and end constraining moment Q has been performed above. (See equation (2a).)

By minimum strain energy

$$\frac{\partial U}{\partial W} = \frac{\partial U_1}{\partial F}\cdot\frac{dF}{dW} + \frac{\partial U_2}{\partial P}\cdot\frac{dP}{dW} = 0$$

$$\therefore \frac{Fl^3}{12EI}\cdot\frac{dF}{dW} + \frac{6}{5}\frac{Fl}{GA}\cdot\frac{dF}{dW} + \frac{4Pl}{\lambda E_1 dt}\cdot\frac{dP}{dW} = 0 \quad (11)$$

substituting (7), (8), (9), and (10) in (11) a relation between W and T is found, viz.,

$$W\left[\frac{l^3}{3EI} + 4\left(\frac{6}{5}\frac{l}{GA}\right) + d\left(\frac{4l}{\lambda E_1 h^2 t}\right)\right] = T\left[\frac{l^3}{6dEI} + \frac{2}{d}\left(\frac{6}{5}\frac{l}{GA}\right) + \frac{4l}{\lambda E_1 h^2 t}\right] \quad .. \quad .. \quad .. \quad .. \quad (12)$$

The deflection of the side beam is given by

$$\delta = \frac{\partial U}{\partial F} = F\left(\frac{l^3}{12EI} + \frac{6}{5}\frac{l}{GA}\right) \text{ where } F = \left(2W - \frac{T}{d}\right)$$

In the case of tension fields at 45° to the grain, that is in specimens 2 and 3, the value of the symbols in expression (12) are :—

$$E_1 = \begin{matrix} E &= 1.75 \times 10^6 \text{ lb./in.}^2 \\ E_{45} &= .50 \times 10^6 \text{ lb./in.}^2 \\ G_{90} &= .135 \times 10^6 \text{ lb./in.}^2 \\ A &= .325 \text{ ins.}^2 \\ I &= 5.8 \text{ ins.}^4 \\ \lambda &= .753 \text{ for this particular frame only.} \end{matrix}$$

$$\therefore W\left[\frac{8500}{10^6} + \frac{3050}{\lambda E_1}\right] = T\left[\frac{265.5}{10^6} + \frac{190.5}{\lambda E_1}\right]$$

from which W = 93 lb. and F = 61 lb.

$$\therefore \delta = \frac{F(2125)}{10^6} = .13 \text{ ins. calculated deflection}$$

$$\delta = .128 - .132 \text{ measured deflection.}$$

This exact agreement between calculated deflection and measured deflection is factitious in the foregoing analysis. But a check may be performed by using Batho's method for thin walled sections in conjunction with bending theory. That is, the box wing test specimen is regarded as resisting torsion partly by twisting as a tube and partly by opposite bending of the side beams. The shear constant G used in Batho's formula is replaced by $\frac{\lambda E_1}{4}$ where λE_1 is the elastic constant of the field along the tension diagonals. A correction to take into account the composite material must be made in the matter of the ply webs, however.

Here $T = Q + W.d \quad .. \quad .. \quad .. \quad .. \quad (13)$
where Q is the torque resisted by the tube
and W is the load on the side beams.

$Q = T - Wd$ so that $\frac{dQ}{dW} = -d$

Strain Energy of Tube.

$$U_1 = \frac{1}{2}Q\theta = \frac{1}{2}Q\left[\frac{Ql}{K}\right] = \frac{Q^2l}{2K}$$

where $K = \frac{4A^2G}{\int\frac{ds}{t}} = \frac{A^2\lambda E_1}{\int\frac{ds}{t}}$

TABLE 8. COMPARISON OF TORSIONAL DEFLECTIONS.

Specimen.	λ	Measured Deflection at Sid: Beam. In.	A Deflection by First Analysis.	B Deflection by Batho's Method.	Percentage Ratio of Stiffness. B/A.
Uncovered Frame...	—	.422	.486	—	Calculated / Measured 87%
(1) ...	1.05	.072	.073	.0813	88.5%
(2) ...	.753	.128	.130	.134	97%
(3) ...	.753	.132	.130	.134	97%

and $\int \frac{ds}{t} = 25.4\left[32 + \frac{10}{3}\cdot\frac{\lambda E_1}{4G_{90}}\right]$

Strain Energy of Two Side Beams.

$$U_2 = 2\left[\frac{W^2l^3}{24EI} + \frac{3}{5}\frac{W^2l}{GA}\right]$$

$$U = U_1 + U_2$$

$$U = 2\left[\frac{W^2l^3}{24EI} + \frac{3}{5}\frac{W^2l}{GA}\right] + \frac{Q^2l}{2K}$$

$$\frac{\partial U}{\partial W} = \frac{\partial U_1}{\partial W} + \frac{\partial U_2}{\partial Q}\cdot\frac{dQ}{dW} = 0$$

That is $W\left[\frac{1}{2}\left(\frac{l^3}{3EI}\right) + 2\left(\frac{6}{5}\frac{l}{GA}\right) + \frac{d^2l}{K}\right] = \frac{Tdl}{K}$

Using the same values for the constants

$$\int \frac{ds}{t} = 25.4\,[32 + 6.17\lambda E_1]$$

$$= 872$$

$$K = \frac{80^2 \times .753 \times .5 \times 10^6}{872} = 2.77 \times 10^6$$

$$W\left[\frac{1}{2}\left(\frac{3380}{10^6}\right) + 2\left(\frac{1280}{10^6}\right) + \frac{12000}{K}\right] = \frac{T \times 750}{K}$$

$$\therefore W = 63.2 \text{ lb.}$$

$$\delta = W\left(\frac{2125}{10^6}\right) = .134 \text{ ins.}$$

δ from first method = .130 ins.

$$\therefore \text{Percentage Ratio } \frac{\text{Calculated Stiffness}}{\text{Measured Stiffness}} = 97\%$$

In Table 8 the values of λ for different tension fields are given together with the measured deflections from Table 4 and the calculated deflections based on the foregoing discussion.

It is now remarked that the introduction of the constant λ might well have been avoided if the flexible boundary girders had been sufficiently supported by numerous intermediate ribs and also that the length of the specimen had been greater.

There seems, however, sufficient evidence that *actual* values of the elastic constants of spruce and ply-wood are close to those used above. The foregoing analyses were undertaken to establish this evidence, and are in part successful. The following general conclusions may now be drawn, that a wooden wing shell possesses maximum flexural stiffness when the three-ply grain is disposed spanwise, and minimum flexural stiffness when the three-ply grain is disposed at 45° to the span. If diagonal tension fields are developed under torsion, then the shell possesses maximum torsional stiffness when the three-ply grain is disposed at 45° to the span. Otherwise, when the three-ply grain is disposed at 0° and 90° to the span the torsional stiffnesses are equal.

Under combined bending and torsion the shell possesses a maximum stiffness against flutter when the three-ply grain is disposed spanwise. A fore and aft disposition of three-ply over the leading edge, however, offsets the loss of some small portion of flexural stiffness by the greater gain in ease of manufacture.

REFERENCES
1. R & M 1694—A Routine Method of Stressing for Three-Ply Covered Fuselages. By H. Davis.
2. Stresses in Aeroplane Structures. By H. B. Howard.
3. Article—Plane Panel Frames of Very Thin Sheet. By H. Wagner.

A NOTE ON SOME SIMPLE AIRSCREW CONSIDERATIONS*

IT has been known for many years that the working conditions of a blade element at 0.75 of the radius are practically sufficient to characterise the working condition of the whole airscrew. This simplifying hypothesis has gained considerable importance in connection with variable-pitch propellers, and it yields some general conclusions which the more exact theories would not show so readily.

The idea is to replace the whole of the airscrew blades by a " wing," turning round with a speed equal to that of an element at 0.75 of the airscrew radius The wing area is quite arbitrary ; we may take it equal to the square of the diameter D. Then we have, with the usual notation, according to Fig. 1 :

$$\text{Thrust } T = \frac{\rho v_r^2}{2}\cdot D^2\,(C_L\cos\phi - C_D\sin\phi)$$

$$\text{Torque } Q = \frac{3}{8}\cdot\frac{\rho v_r^2}{2}\cdot D^3\,(C_L\sin\phi + C_D\cos\phi)$$

$$\phi = \arctan\frac{8}{3}\cdot\frac{v}{D.\omega}$$

β being the blade angle at 0.75 R, the incidence is

$$\alpha = \beta - \phi$$

If T and Q are known from experimental data, it is possible to determine C_L and C_D, the lift and drag coefficients of the hypothetical wing. This has been done in Fig. 2, which applies to the series of two-bladed metal propellers, taken from N.A.C.A. Report No. 350. Obviously, this " polar representation " of airscrew characteristics is a very simple one, since only one curve is sufficient for propellers of different pitches. The efficiency may be expressed in the manner shown overleaf.

* Communicated by W. S. Shackleton, Ltd.

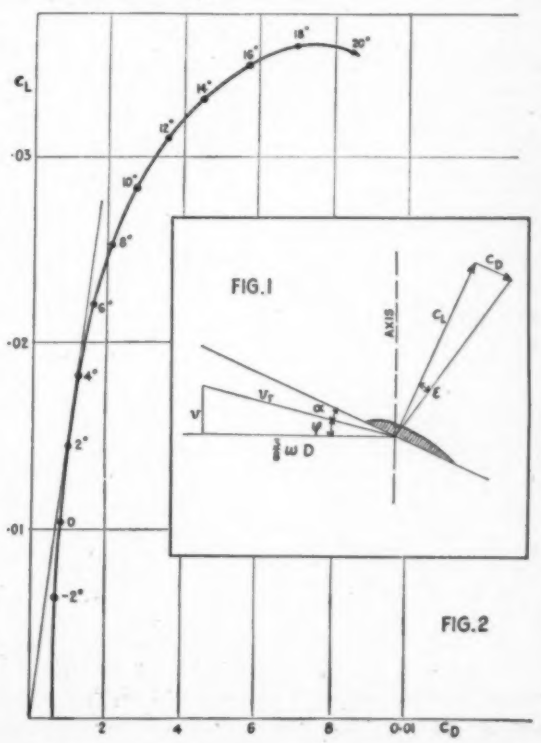

FIG.2

$$\eta = \frac{T \cdot v}{Q \cdot \omega} = \frac{C_L \cos\phi - C_D \sin\phi}{C_L \sin\phi + C_D \cos\phi} \cdot \tan\phi$$

or, putting $C_D/C_L = \tan\epsilon$

$$\eta = \frac{\cos\phi - \tan\epsilon \cdot \sin\phi}{\sin\phi + \tan\epsilon \cdot \cos\phi} \cdot \tan\phi = \frac{\tan\phi}{\tan(\phi + \epsilon)}$$

This expression has its maximum value

$$\eta_{max.} \simeq A - 2\epsilon \text{ with } \tan\phi \simeq A - \frac{\epsilon}{2}.$$

The values of α and ϵ being small, maximum efficiency is obtained with a blade angle β of about 45°. The more exact figures, corresponding to the given polar curve, would be :

$$\alpha = 2°,\ \epsilon = 0.0625 = 3.5°;\ \phi = 44°;$$
$$\eta_{max.} = 0.875;\ \beta = 46°.$$

With modern flying speeds and geared-down propellers, we are very near this optimum value, and further increase in flying speed would lead to decreased maximum efficiency, unless this is counterbalanced by higher circumferential speed. Other considerations—approach to the speed of sound, energy loss through emission of sound waves, etc.—make it impossible to maintain the 45° blade angle by increasing the circumferential speed; therefore, it seems interesting to see what would happen for an airscrew with infinite pitch and 90° blade angle.

Such a propeller would consist only of a number of straight wings set parallel to the axis, like in a centrifugal fan of very simple design. Obviously, such an airscrew could not give any thrust at low speeds, unless it were of the variable-pitch type. For a blade angle of 90° we can put :

$$\tan\phi = \cot\alpha \simeq \frac{A}{\alpha},\quad \eta = \frac{A - \epsilon/\alpha}{A + \epsilon \cdot \alpha} \simeq A - \epsilon/\alpha$$

Taking the symmetrical aerofoil N.A.C.A. 0009, the maximum value would be

$$\eta_{max.} = 0.55$$

which is not very promising—for an incidence of about 18°. Nevertheless, such an airscrew would have the advantage that very thin—"supersonic"—profiles could be employed, owing to the absence of all twisting efforts. The possibility of fitting a greater number of blades—say 6 or 8, because there would be very little interference—would, in turn, make it possible to reduce the necessary section and diameter and to save both weight and air friction losses.

AERONAUTICAL PATENT SPECIFICATIONS

The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

(*Published May* 11, 1939.)

27423. CLEVELAND, F. J. (Bendix Aviation Corporation): Hydraulic braking systems (503,614).
27867. DOWTY, G. H.: Retractable undercarriages for aircraft (503,789).
29375. BRISTOL AEROPLANE CO., LTD., FEDDEN, A. H. R., COPLEY, J. W., and FORTESCUE, P.: Cooling arrangements for air-cooled radial-cylinder engines of aircraft (503,690).
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(*Published May* 18, 1939.)

24897. JABLONSKY, B.: Manufacture of compressed wood (504,025).
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3603. TELEFUNKEN GES. FUR DRAHTLOSE TELEGRAPHIE: Radio direction-finding receivers (504,060).
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33787. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES.: Gas-turbines (504,263).

(*Published May* 25, 1939.)

25122. DE HAVILLAND AIRCRAFT CO., LTD., and KING, E. P.: Hollow moulded plastic airscrew blades (504,377).
29173. HUTCHISON, H. H., and GIBSON, J. J.: Rotary-wing aircraft (504,718).
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32522. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES.: Linear dimension measuring apparatus (504,707).
33992. FAIREY AVIATION CO., LTD., LOBELLE, M. J. O., and VOSS, E.: Mountings for guns and the like for use on aircraft, motor-boats, and ships and similar positions (504,551).

(*Published June* 1, 1939.)

21532. UNITED AIRCRAFT CORPORATION: Controllable pitch propellers (505,077).
29650. BENDIX AVIATION CORPORATION: Tachometer (505,086).
30011. JOSSELYN, J., and BLAKE, R. (Legal representatives of LA CIERVA Y CORDORNIU, J. DE (deceased): Aircraft sustaining and/or lifting rotors (504,942).
30282. GENERAL AIRCRAFT, LTD., WILLIAMS, D. L. H., and CROCOMBE, F. F.: Landing-gear arrangements of aircraft (505,109).
30482. VICKERS (AVIATION), LTD., and WALLIS, B. N.: Wing construction of aircraft (505,201).
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36106. FAIREY AVIATION CO., LTD., and ORDIDGE, F. H.: Mounting of guns on aircraft (505,230).
16386. JUNKERS FLUGZEUG-UND-MOTORENWERKE AKT.-GES.: Cockpits for aircraft (504,980).
23105 BAYERISCHE MOTOREN WERKE AKT.-GES.: Oil-cooler for aircraft (504,992).
28665. CIERVA AUTOGIRO CO., LTD., and BENNETT, J. A. J.: Aircraft sustaining rotors (504,894).
31327. HENSCHEL FLUGZEUG-WERKE AKT.-GES.: Light permeable or transparent double walls for compartments of high altitude aircraft (504,902).
34409. GENERAL AIRCRAFT, LTD., WILLIAMS, D. L. H., and CROCOMBE, F. F.: Landing gear arrangements for aircraft (505,263).
37441. CLARKE, CHAPMAN & CO., LTD., WOODESON, W. A., and MIDGLEY, W.: Crane equipment for the recovery of seaplanes and boats (504,908).
5335. UNITED AIRCRAFT CORPORATION: Screw propellers (505,168).
5336. UNITED AIRCRAFT CORPORATION: Screw propellers (505,169).

Heat-resisting Alloys

VARIOUS desirable qualities in heat-resisting alloy steels and various factors which make these qualities difficult to attain in standard products, are explained in considerable detail in a booklet issued by Darwins, Ltd., of Fitzwilliam Works, Sheffield. The publication goes on to describe the characteristics of the range of "Pireks" heat-resisting alloys. These alloys, of which there are nine different varieties, are supplied in the form of bar, sheet, wire and castings.